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Studies on Intestinal Trematodes in Korea

IX. Recovery Rate and Development of *Fibricola seoulensis* in Experimental Animals

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INTRODUCTION

The fluke genus *Fibricola* Dubois, 1932 is the intestinal trematode of mammals and belongs to the family Diplostomatidae Poirier, 1886 (Sudarikov, 1960; Yamaguti, 1958). The type species is *Fibricola cratera* (Barker and Noll, 1915) Dubois, 1932, which was firstly found from muskrat in the United States (Sudarikov, 1960). *Fibricola seoulensis*, another species (Seo *et al.*, 1964), was firstly described from the small intestine of house rats in Seoul. This fluke is now known to distribute widely in inland Korea (Seo *et al.*, 1981). Recently, a case of human infection was found in this country (Seo *et al.*, 1982) and more attentions seem to be paid to this intestinal fluke.

From the view point of public health and to prevent further human infections, studies on various characteristics of *F. seoulensis* infection are important. Searching for the source of infection, for example, *i.e.*, intermediate or reservoir hosts, is one of the essential steps. As for the second intermediate hosts, the metacercariae were already demonstrated from the tadpoles and frogs, *Rana nigromaculata*, as well as the snakes, *Natrix tigrina lateralis* (Hong *et al.*, 1982 & 1983; Cho *et al.*, 1983). It was also indicated that the human case had the history of eating raw viscera of snakes before the onset of symptoms and the source of infection was considered the snakes (Seo *et al.*, 1982).

On the reservoir hosts of *F. seoulensis*, however, not many studies have been undertaken. Only house rats and man are known to be naturally infected (Seo *et al.*, 1964, 1981 & 1982), and albino rats, mice and guinea pigs were susceptible for experimental infection (Hong, 1982; Cho *et al.*, 1983). In case of other species of *Fibricola*, some wide range of mammals such as rodents, carnivores and insectivores are known to be the final hosts (Sudarikov, 1960). Therefore, there may be other kinds of susceptible hosts in nature for *F. seoulensis* infection, and the determination of susceptibility of laboratory animals is one of the alternative methods to know the possible kinds of natural hosts.

In this respect, this study was carried out to observe the susceptibility of laboratory animals such as albino rats, mice, dogs, cats, rabbits and chickens for experimental infection with the metacercariae of *F. seoulensis*.

MATERIALS AND METHODS

1. Collection of the Metacercariae (Diplostomula)

From September to November 1982, a total

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of 30 snakes, *Natrix tigrina lateralis* were purchased from a local collector in Hoengsŏng-gun, Kangwon-do. The total body of the snakes was flayed and chopped with scissors and then mixed with 10-fold volume of artificial gastric juice with stirring, and the mixture was incubated at 37°C overnight. The digested mixture was washed two times with normal saline and the liberated metacercariae were counted 50, 100, 200, 500, 1,000 and 2,000 in number for grouping of experimental infection.

2. Experimental Infection and Recovery of Worms

A total of 74 albino rats (Sprague-Dawley strain) were divided into 5 groups according to the amount of metacercariae to be infected (50, 100, 200, 1,000 and 2,000 in number) and 40 mice (ICR strain) into 4 groups (50, 100, 200 and 500 in number). Other animals such as dogs, cats, rabbits and chickens were infected with 500 metacercariae each (Table 1). The metacercariae were fed to albino rats and mice through polyethylene capillary tube inserting into stomach under ether anesthesia. In case of dogs, cats and rabbits, rubber catheters were used to infect them without anesthesia, and chickens were fed the metacercariae with medium-size spoid also without anesthesia.

After 3 days, 1, 2, 4 and 8 weeks after infection, the infected animals were sacrificed according to schedules (Table 1). After sacrifice, the whole length of small intestine was resected. The resected small intestine was separated into 4 parts in physiological saline: duodenum 1 (D_1-proximal duodenum to bile duct opening), duodenum 2 (D_2-distal duodenum from bile duct opening), jejunum and ileum. The lumen was opened with a pair of scissors along the mesenteric border and kept in 4°C refrigerator overnight in order to detach and relax worms. The freed worms were collected under dissecting microscope. Then they were stained with Semichon's acetocarmine.

The recovery rates in various animals were obtained according to the amount of metacercariae infected as well as the duration of infection. For determination of the worm maturity, 27~40 worms recovered 1 week after infection

Table 1. Number of infected animals according to the amount of metacercariae and duration of infection

Host	No. of Mc*	Infection period					Total
		3 days	1 week	2 weeks	4 weeks	8 weeks	
Albino rat	50	3	3	4	3	—	13
	100	3	3	3	3	—	12
	200	3	2	6	3	3	17
	1,000	3	6	3	3	—	15
	2,000	3	3	4	5	2	17
	Subtotal	15	17	20	17	5	74
Mouse	50	3	3	4	—	—	10
	100	3	3	3	1	—	10
	200	3	4	3	1	—	11
	500	3	3	3	—	—	9
	Subtotal	12	13	13	2	—	40
Dog	500	—	1	1	1	1	4
Cat	500	—	2	1	—	—	3
Rabbit	500	—	2	2	—	—	4
Chicken	500	—	2	—	—	—	2
Total		27	37	37	20	6	127

* Metacercariae

from albino rats, mice, dogs and cats were examined under light microscope after staining. The length of anterior as well as posterior segment was separately measured and the length-ratios of posterior/anterior segments were calculated.

The parameters used to assess the susceptibility of animal hosts for experimental infection with *F. seoulensis* were as follows:

a) The comparative worm recovery rates 1 week after infection from 6 kinds of laboratory animals

b) The recovery rates according to duration of infection in each animal

c) The maturity index (No. mature worms/ No. examined) of the recovered worms, which was determined by presence of intrauterine eggs and the length-ratio of posterior/anterior segments.

RESULTS

1. Worm Recovery Rates

The overall recovery rate of *F. seoulensis* from albino rats was 40.0% (Table 2). It was shown that the recovery rate varied from 30.4 to 62.1% according to the amount of metacercariae infected and from 11.0 to 60.5% according to the duration of infection. There was no exact correlation between the worm recovery rate and the amount of metacercariae infected. The highest recovery rate of 62.1% was obtained when 1,000 metacercariae were infected to albino rats. However, an apparent decreasing tendency of the recovery rate was seen according to the infection duration, *i.e.*, the rates were 60.5% (3rd day), 52.9% (1st week), 34.8% (2nd week) 27.9% (4th week) and 11.0% (8th week).

In case of mice, the overall worm recovery rate was 33.9% and the rate also varied according to the amount of metacercariae and to the duration of infection. The highest recovery rate was 46.0% when 200 metacercariae each were given. The chronological decreasing tendency of the recovery rate was also noted, *i.e.*, 56.2% (3rd day), 25.8% (1st week), 21.1% (2nd week) and 34.0% (4th week).

The recovery rate from dogs was 11.4% in average and the chronological decreasing tendency of the recovery rate was more significant, *i.e.*, 38.4% (1st week), 5.6% (2nd week), 1.0%

Table 2. Recovery rate of *F. seoulensis* in several hosts by infection period and dose

Host	No. of *Mc	No. of animals	Recovery rate(%) after					Total
			3 days	1 week	2 weeks	4 weeks	8 wees	
Albino rat	50	13	39.3	54.7	34.0	44.7	—	42.5
	100	12	29.0	42.3	30.0	27.7	—	32.3
	200	17	51.2	67.3	45.1	25.2	21.8	41.1
	1,000	15	45.2	66.0	75.8	57.5	—	62.1
	2,000	17	71.2	39.4	18.1	18.9	9.4	30.4
	Subtotal	74	60.5	52.9	34.8	27.9	11.0	40.0
Mouse	50	10	30.7	42.7	55.5	—	—	44.2
	100	10	30.3	23.0	35.7	43.0	—	31.0
	200	11	54.0	47.5	41.3	29.5	—	46.0
	500	9	64.7	14.7	18.8	—	—	32.8
	Subtotal	40	56.2	25.8	21.1	34.0	—	33.9
Dog	500	4	—	38.4	5.6	1.0	0.4	11.4
Cat	500	3	—	30.1	2.6	—	—	20.9
Rabbit	500	4	—	0	**0.1	—	—	0.05
Chicken	500	2	—	0	—	—	—	0

* Metacercariae

** Only one worm was recovered from duodenum

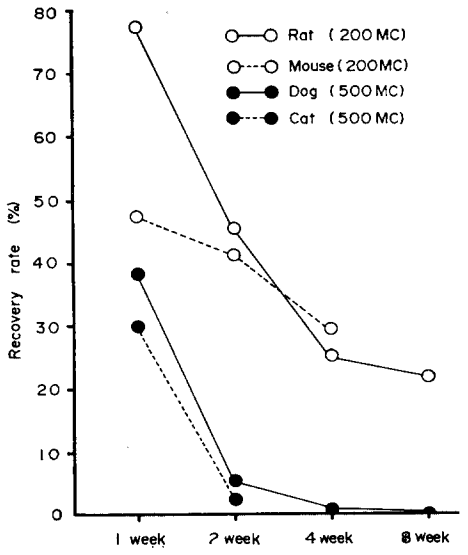

Fig. 1. Chronological recovery rates of *F. seoulensis* from albino rats, mice, dogs and cats.

(4th week) and 0.4% (8th week). In cats, the recovery rate was 20.9% in average and the rate at 1 week was 30.1% but decreased also significantly to 2.6% at 2 weeks. These observations mean that dogs or cats are infected well during the early stage but the worms are expelled more rapidly than in albino rats and mice afterwards (Fig. 1).

In case of 4 rabbits to which 500 metacercariae were given, only 1 adult(0.05%) strigeid fluke was recovered from the duodenum of 1 rabbit after 2 weeks. However, from 2 chickens, there was not a single worm found 2 weeks after infection.

2. Distribution of Worms in the Small Intestine

In albino rats of 50, 100 and 200-metacercariae infection groups, almost all (95~100%) of the recovered worms were found from the duodenum (D_1 and D_2 in Table 3). On the other hand, in 1,000 or 2,000-metacercercariae group, the average number of worms recovered from the duodenum, jejunum or ileum was 498 ~513, 122~212 or 1~16 respectively and the worms collected from the duodenum was only 70~80% of all recovered. It seems that, as the amount of metacercariae increases from 50 to 2,000, the distribution of worms tends to extend toward the jejunum or even ileum (Table 3 & Fig. 2).

Another tendency of the location of worms was recognizable in albino rats. The tendency is that the most favorable site of *F. seoulensis* is likely to be the proximal half of the duod-

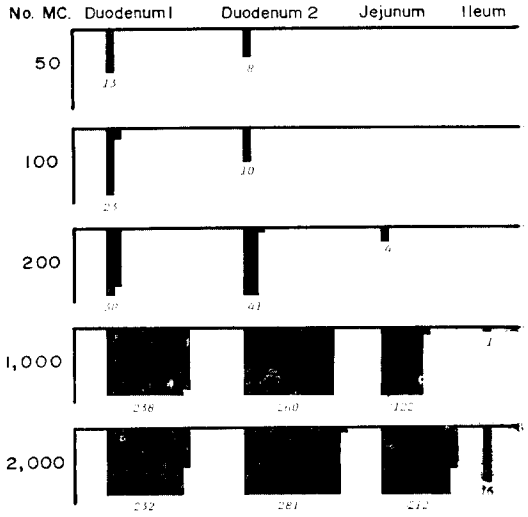

Fig. 2. Numerical distribution of *F. seoulensis* in small intestine of albino rats according to the amount of metacercariae infected.

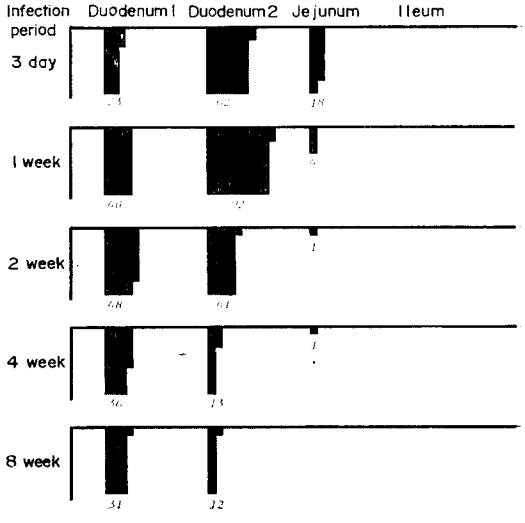

Fig. 3. Chronological distribution of *F. seoulensis* in small intestine of albino rats infected with 200 metacercariae by number of worms.

Table 3. Numerical distribution of *F. seoulensis* recovered from small intestine of albino rats by infection period and dose

No. MC	Infec. period	No. worms recovered from			
		*D_1	**D_2	Jejunum	Ileum
50	3 day	7	11	2	0
	1 week	16	12	0	0
	2 week	12	5	0	0
	4 week	17	5	0	0
	Average	13	8	0.2	0
100	3 day	12	17	0	0
	1 week	31	11	0	0
	2 week	26	4	0	0
	4 week	21	7	0	0
	Average	23	10	0	0
200	3 day	23	62	18	0
	1 week	40	92	4	0
	2 week	48	41	1	0
	4 week	36	13	1	0
	8 week	31	12	0	0
	Average	38	41	4	0
1,000	3 day	179	197	71	5
	1 week	230	273	157	0
	2 week	287	336	135	0
	4 week	266	221	88	1
	Average	238	260	122	1
2,000	3 day	356	543	466	59
	1 week	246	341	198	2
	2 week	169	126	67	1
	4 week	147	113	115	3
	Average	232	281	212	16

* D_1 : Proximal duodenum to bile duct opening
** D_2 : Distal duodenum from bile duct opening

Table 4. Numerical distribution of *F. seoulensis* recovered from small intestine of several hosts by infection period and dose

Host	No. MC	Infec. period	No. worms recovered from			
			*D_1	**D_2	Jejunum	Ileum
Mouse	50	3 day	7	8	0	0
		1 week	17	5	0	0
		2 week	12	11	5	0
		Average	12	8	2	0
	100	3 day	17	9	1	4
		1 week	19	4	0	0
		2 week	2	31	2	1
		4 week	18	21	0	4
		Average	13	15	1	2
	200	3 day	31	67	30	0
		1 week	42	53	0	0
		2 week	2	44	37	0
		4 week	6	21	32	0
		Average	20	51	16	0
	500	3 day	90	199	34	0
		1 week	45	26	2	0
		2 week	19	41	34	0
		Average	51	89	23	0
Dog	500	1 week	11	156	25	0
		2 week	5	17	6	0
		4 week	0	4	1	0
		8 week	0	1	1	0
		Average	4	45	8	0
Cat	500	1 week	25	76	46	5
		2 week	2	9	2	0
		Average	17	53	31	3

* D_1 : Proximal duodenum to bile duct opening
** D_2 : Distal duodenum from bile duct opening

enum (D_1). In 200-metacercariae infection group, for example, the worms recovered from D_1 was relatively constant in number throughout the infection period, while those from D_2 (distal duodenum) remarkably decreased from 92(lst week) to 12(8th week) in number as infection progressed (Table 3 & Fig. 3).

The location of the recovered worms from mice was similar to that observed in albino rats (Table 4 & Fig. 4). In 50 and 100-metacercariae groups, the majority (about 90 %) of worms were recovered from the duodenum, however, only 82~86% from the same segment (D_1 and D_2) in 200 and 500-metacercarie groups. Therefore, the extension of worm distribution to jejunum according to the increase of infection dose was also recognizable in mice (Fig. 4).

In dogs or cats to which 500 metacercariae each were given, many worms (67 or 86% respectively) were recovered from the duodenum but some were also found from the jejunum (Table 4).

3. The Maturity of the Recovered Worms

In case of the recovered worms from albino rats, the average values of the length of anterior and posterior segments were 679.3 and

624.1μm respectively (1,303μm in total) when 30 worms of 1-week of age were measured (Table 5). In mice, those of 30 worms of 1-week of age were a little larger than those from albino rats, and the values were 745.9 and 627.1μm respectively (1,373μm in total). On the other hand, those from dogs were smaller and 607.7 and 252.4μm (860μm in total) in 27 worms measured, and those from cats were 572.1 and 116.9μm (689μm in total) in 40 measured. The average length-ratio of posterior/anterior segments of the recovered worms was 0.93(0.75~1.36 in range) in albino rats, 0.84 (0.65~1.31) in mice, 0.42 (0.14~0.80) in dogs and 0.20 (0.09~0.37) in cats.

The mean number of intrauterine eggs of 1-week aged worms collected from albino rats was 14.4 (1~29 in range) among 30 worms examined (Table 6). And 3, 6, 16 and 5 worms contained 1~5, 6~10, 11~20 and 21~30 eggs respectively. In case of 30 worms from mice, the number of intrauterine eggs was 13.0 in average (3~29 in range). But only 2 worms contained 10 or 15 eggs among 27 worms from dogs and the average value of intrauterine eggs was as low as 0.93 in number. A total of 40 worms collected from cats were examined, however, none of them had intrauterine eggs.

When the term 'mature worm' is defined as that containing any eggs in their uteri, the lowest criterion of the length-ratio of posterior/anterior segments to become mature worm was 0.58 in this study. In case that the worm maturity is determined by the above criteria, the maturity index (No. mature worms/No. examined) of the recovered worms from albino rats, mice, dogs or cats was 100%, 100%, 22.7% or 0% respectively (Table 7).

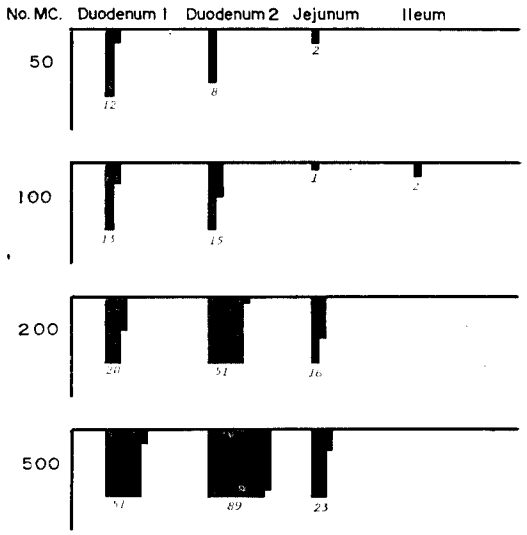

Fig. 4. Numerical distribution of *F. seoulensis* in small intestine of mice according to the amount of metacercariae infected.

DISCUSSION

The susceptibility or suitability of laboratory animals to trematode infections has been estimated through observation of the worm recovery rate as well as the maturity of worms after experimental infection with the metacercariae. Such examples of trematode parasites are *Clonorchis sinensis* (Wykoff, 1958; Rhee *et* Seo, 1968), *Metagonimus yokogawai* (Yokogawa *et* Sano, 1962; Hong *et* Seo, 1969) or *Pygidiopsis*

Table 5. Ratio of posterior/anterior segments of one week old *F. seoulensis* collected from several hosts

Host	No. of animals	No. of worms measured	Average(range) length(μm)		Average(range) ratio of post./ant. segments
			Ant. segment	Post. segment	
Albino rat	2	30	679.3±114.2*(480.8~923.0)	624.1±115.7(423.1~884.6)	0.93(0.75~1.36)
Mouse	4	30	745.9±103.8 (557.7~903.8)	627.1± 99.1(438.8~750.0)	0.84(0.65~1.31)
Dog	1	27	607.7±146.4 (311.6~980.7)	252.4±147.2(115.4~673.1)	0.42(0.14~0.80)
Cat	2	40	562.6±159.1 (338.1~903.8)	131.7± 67.6 (33.2~326.9)	0.20(0.09~0.37)

* One standard deviation

Table 6. Distribution of worms by the number of intrauterine eggs in one week old *F. seoulensis* collected from several hosts

Host	No. worms	Distribution of worms						Mean No. eggs per worm (range)
		No. of intrauterine eggs						
		0	1~5	6~10	11~20	21~30	over 31	
Albino rat	30	0	3	6	16	5	0	14.4 (1~29)
Mouse	30	0	3	7	15	5	0	13.0 (5~29)
Dog	27	25	0	1	1	0	0	0.93(0~15)
Cat	40	0	0	0	0	0	0	0

Table 7. Maturity of one week old *F. seoulensis* collected from several hosts

Host	No. of worms			*Maturity (%)
	Examined	Immature	Mature	
Albino rat	30	0	30	100.0
Mouse	30	0	30	100.0
Dog	27	22	5	22.7
Cat	40	40	0	0

* If a worm had eggs or the ratio of posterior/anterior segments was over 0.58, it was defined as a mature one

genata (Mansour *et al.*, 1982). However, as for the genus *Fibricola*, no detailed study has been done by experimental infection to various animals.

In the present study, six kinds of laboratory animals, *i.e.*, albino rats, mice, dogs, rabbits and chickens were tested for the susceptibility to *F. seoulensis* infection and it is concluded that albino rats and mice are the most susceptible animals. This conclusion is based on the higher recovery rate and maturity index of the recovered worms from the rodents than other hosts.

The infectivity of the fluke genus *Fibricola* to carnivorous animals such as cats and dogs seems to be variable according to the species of the fluke. In case of *F. texensis*, 3 kittens infected with about 50 metacercariae were negative for worms after 2 weeks (Chandler, 1942), on the other hand, *F. cratera* was successfully infected to cats and attained sexual maturity in 8 to 10 days (Cuckler, 1940). As for *F. seoulensis*, the worm recovery rate 1 week after infection from dogs or cats were relatively high (30~38%) but it rapidly decreased after 2 weeks (less than 6%). The reason for the abrupt decrease of the recovery rate after 2 weeks is not clearly understood, however, this phenomenon seems to be due to natural discharge of the worms. If so, it implies that the condition of dog or cat intestine, physiological or immunological, is not suitable for successful maintenance of parasitism by *F. seoulensis.*

It is interesting that only one adult of *F. seoulensis* was collected from 1 among 4 rabbits infected with 500 metacercariae each. It means poor susceptibility of the rabbits, hence, they are not considered the suitable experimental animal for *F. seoulensis* infection. Quite comparably, bile duct of the rabbits is known to be a good habitat of *C. sinensis* by experimental infection (Wykoff, 1958; Sun *et al.*, 1968; Lee *et al.*, 1973), even though they do not eat the fish intermediate hosts in nature.

As expected, no diplostomatid fluke was found in 2 chickens fed with 500 metacercariae each of *F. seoulensis* in the present study. As described by Seo *et al.* (1982), there had been some debates on the nomenclature of two genera of diplostomatids from mammals and birds, *Fibricola* and *Neodiplostomum*, because of morphological similarity. However, the debates cleared up by placing those from mammals in the genus *Fibricola* and those from birds in the genus *Neodiplostomum* (Yamaguti, 1958). Although it was possible to infect young chicks with the metacercariae of *F. texensis* and *F.*

cratera, many worms discharged spontaneously within a short time (Leigh, 1945; Ulmer, 1955). Similarly, the experimental infection of chickens and one domestic pigeon with the larvae of *F. cratera* gave negative results (Hoffman, 1955; Ulmer, 1955). It is undoubtedly true that biologically the flukes of the genus *Fibricola* are not parasites of avian hosts.

So far as the recovery rates from albino rats and mice are concerned, a speculation is made that the biological capacity of the duodenum should be about 500 and 100 adults of *F. seoulensis* respectively in these animals. It was shown that the duodenum of albino rats infected with 1,000~2,000 metacercariae was occupied by a maximum of about 500 worms and the remainder shifted to lower parts of small intestine, *i.e.*, jejunum or ileum. Also in mice to which 200~500 metacercariae were given, about 70~140 worms distributed in the duodenum while others down to jejunum. These figures mean that the number of worms is relatively constant in the duodenum of each animal regardless of infection dose while not in the jejunum where the number varies according to infection dose.

If the biological capacity of the duodenum of albino rats and mice is accepted, the highest recovery rates in these animals infected with 1,000 and 200 metacercariae respectively is explained well. Moreover, in the above cases, a considerable number of worms persisted in the duodenum even until 4 or 8 weeks after infection. Therefore, it can be said that the optimum amount of metacercariae of *F. seoulensis* is 1,000 for albino rats and 200 for mice.

It is well known that the fluke family Diplostomatidae has bi-segmented bodies, *i.e.*, the anterior and posterior segments. It is also known that the development of *F. seoulensis* is characterized by marked enlargement of the posterior segment in comparison with slight enlargement of the anterior one in albino rats and mice (Hong, 1982). On this account, the developmental status or maturity of worms was determined in this study by the length-ratio of posterior/anterior segments, and it was observed that the minimum ratio of worms containing intrauterine eggs was 0.58. Therefore, the ratio 0.58 seems to be a good index to discriminate mature worms of *F. seoulensis*.

It was reported that 6 to 7 days are required for *F. seoulensis* to grow and sexually mature in albino rats and mice (Hong, 1982; Cho *et al.*, 1983). In case of *F. cratera*, it took 8 to 10 days to become adults in rats, mice and cats (Cuckler, 1940). In the present study, all of the worms recovered from albino rats and mice 1 week after infection were mature ones over 0.58 in the length-ratio. This result indicates that albino rats and mice are the best laboratory animals for experimental research of *F. seoulensis* infection.

From the results of this study, it is suggested that the most important reservoir hosts of this fluke should be the rodents such as house rats, wild rats, and so on. The carnivorous animals such as dogs or cats may be naturally infected but seems not important as reservoir hosts.

SUMMARY

An experimental study was carried out to observe the susceptibility of several kinds of laboratory animals to *Fibricola seoulensis* infection, a diplostomatid fluke of mammals. The metacercariae were obtained from the viscera of the snakes, *Natrix tigrina lateralis* and 50~2,000 in number each was artificially fed to a total of 127 animals; albino rats, mice, dogs, cats, rabbits and chickens. After 3 days to 8 weeks the animals were sacrificed and the recovery rate of worms as well as their maturity was observed.

The results are as follows:

1. The overall worm recovery rates throughout the experimental period was highest in albino rats (40.0%) followed by mice (33.9%), cats (20.9%), dogs (11.4%), rabbits (0.05%) and chickens (0%). However, the recovery rates in the same host decreased as infection progressed longer and variable by the amount

of metacercariae given.

2. From albino rats and mice, the highest recovery rates were obtained in 1,000 and 200-metacercariae infection groups respectively, and it is considered that such amount should be the optimum dose for experimental infection of these animals.

3. The main location of *F. seoulensis* in experimental animals was small intestine especially the duodenum.

4. The maturity index (No. mature worms/No. examined) was 100% in albino rats and mice, while only 22.7% or 0% in dogs or cats respectively.

From the results, it is concluded that albino rats and mice are the most susceptible hosts for *F. seoulensis* infection among six kinds of laboratory animals examined.

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=국문초록=

韓國의 腸吸蟲에 관한 硏究

IX. 實驗動物내에서의 *Fibricola seoulensis* 蟲體回收率 및 發育

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몇가지 實驗動物의 *Fibricola seoulensis* 實驗感染에 對한 感受性을 알아보고 宿主로서의 適合度를 觀察하고자 中間宿主로 알려진 뱀으로부터 被囊幼蟲을 分離하여 50~2,000개群으로 나누고 흰쥐, 마우스, 개, 고양이, 토끼 및 닭등 總 127마리에 각각 實驗感染시킨 다음 3일부터 8週까지 각 宿主內에서의 蟲體回收率및 蟲體成熟度를 관찰하고 비교분석하였다.

그 結果는 다음과 같다.

1. 總 蟲體回收率은 흰쥐에서 가장 높아 40.0%이었으며, 그 다음이 마우스로 33.9%이었고, 고양이 20.9%, 개 11.4%, 토끼 0.05% 및 닭 0%의 순으로 나타났다. 충체회수율은 感染期間이 길어짐에 따라 차차 저하되는 경향을 보였으며 感染被囊幼蟲數에 따라서도 다양하게 變化하는 것으로 나타났다.

2. 흰쥐에는 被囊幼蟲 1,000개를, 마우스에는 200개를 感染시켰을때 蟲體回收率이 가장 높았으며 이 정도의 피낭유충수가 이들 동물을 감염시키는데 適當한 感染量으로 생각되었다.

3. 각 실험동물에서 主 寄生部位는 小腸이었고 그 중에서도 특히 十二指腸이었다.

4. 각 동물에서 회수한 蟲體의 成熟度(성숙충체수/관찰충체수)는 흰쥐와 마우스에서 모두 100%이었고 개에서는 22.7%이었으며 고양이에서는 0%로 전혀 성숙된 충체가 없었다.

이상의 結果를 綜合해볼 때 6種의 실험동물중 충체회수율 및 충체성숙도가 높은 흰쥐와 마우스가 *Fibricola seoulensis*의 가장 좋은 好適宿主로 생각되었다.