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Infestation of larval trematodes from fresh-water fish and brackish-water fish in River Wyangpi, Kyungpook Province, Korea*

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=國文抄錄=

王避川 流域 淡水魚와 半鹹水魚에 있어서 吸蟲類 被囊幼蟲 寄生狀

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慶北 蔚珍郡 聖留山밑에 形成된 天然記念物 第 155號인 聖留窟앞으로 흘러내리는 王避川에 棲息하는 淡水魚와 半鹹水魚에서의 吸蟲類 被囊幼蟲 寄生狀을 알아보기 위해 1989年 5月부터 10月까지 王避川 流域에서 投網, 낚시등으로 淡水魚와 半鹹水魚를 採集하였다.

採集된 10種의 魚類에서 5種의 被囊幼蟲과 4種의 所屬未定幼蟲을 檢出할 수 있었으며, 이 가운데 肝吸蟲은 1種의 魚類에서, *Echinochasmus species*와 橫川吸蟲은 3種의 魚類에서, *Exorchis oviformis, Cyathocotyle orientalis*는 2種의 魚類에서 檢出할 수 있었으며, 그 寄生率은 魚種別로 큰 差異를 나타내었다.

魚肉 1g當 肝吸蟲 被囊幼蟲數는 돌고기에서는 0.01個였고, 橫川吸蟲 被囊幼蟲數는 은어에서는 4.17個 였는데 比하여 피래미와 갈견이에서는 各各 0.11個 였다.

以上의 成績으로 미루어 보아 慶北 蔚珍郡 王避川에 棲息하고 있는 淡水魚와 半鹹水魚에서의 吸蟲類 被囊幼蟲 寄生率과 感染度는 비교적 낮았으나, 이들 魚類를 生食하면 肝吸蟲과 橫川吸蟲에 感染될 것으로 思料된다.

Introduction

The studies of infestation patterns for digenetic larval trematodes from fresh-water fish and brackish-water fish in rivers and swamps of Kyungpook Province have been carried out by many investigators since Kobayashi's first reports on encysted larvae of *C. sinensis* from the flesh of several kinds of fresh-water fish in 1920.

In these studies, the infestation rate of larval trematodes in approximately 80 piscine species belonging to 10 families is found to be high, and 10 species of them are now recognized as playing the important role in transmitting digenetic trematodes in the endemic areas of southern Korea.

From their studies on the larval trematodes from fresh-water fish in River Oseep running through Yeongduk county, Kyungpook Province, Lee et al. (1979) reported that 7 kinds of larval trematodes,

* The results of this study were presented at the 28th annual meeting of the Korean Society for Parasitology.

including *C. sinensis* and 2 kinds of larval undetermined larval A and D, were found from 10 species of fish hosts.

Afterwards, results of studies on larval trematodes from fresh-water fish caught in rivers running into the eastern Sea of Korea have been reported by Joo(1980), Joo and Park(1982), Yoo et al.(1984), and Joo(1988) in River Taewha; by Joo(1984) in River Hyungsan; by Roh(1980), and Joo et al.(1983) in River Taechong; by Song and Jeon(1983), Ahn (1984), and Ahn et al.(1987) on comprehensive studies in several rivers of Kyungpook and Kangweon Provinces.

River Wyangpi running through Ulchin county is situated in the northeast part of Kyungpook Province which was incorporated from Kangweon Province in 1963, and is famous for its beautiful basin, i.e., Ulchin Pulyounggyegok(Science place No.6) and Ulchin Seongnyugul cave(Natural Monument No. 155) which is the oldest one in the Orient and is full of exotic stalactites and stalagmites. In this basin, there are many unusual eating houses that sell raw fresh-water and/or brackish-water fish to local residents and visitors.

However, studies on larval trematodes from fish hosts have not been undertaken in the vicinity of the river Wyangpi. The present study reports the infestation patterns of larval trematodes from fresh-water fish and brackish-water fish

Materials and Methods

1. Surveyed area: The river Wyangpi has its origin in the northeastern range of Illweol mountain and flows in an easterly direction. It runs through the central Ulchin county situated in the northern part of Kyungpook Province, where the river meets with the Maewha stream and many rivulets.

It then runs through and joins again with the Kwang stream in the northern part of Seongnyugul cave. Finally, it runs into the eastern Sea of Korea (Fig. 1).

Two localities in the vicinity of the river Wyangpi, i.e., Changpyong and Seongnyu villages in Keonnam myun, Ulchin county, were selected as the surveyed area because many kinds of fresh-water fish and snails are found in the water. More detailed geographical conditions of surveyed areas were presented by Joo et al.(1985).

2. The fish host survey: Fresh-water fish and brackish-water fish were caught in the river Wyangpi by netting and fishing with rod and line.

The fish, after removal of their intestinal contents to prevent autodigestion, were forwarded to the Department of Parasitology Keimyung University, School of Medicine. The specific name of the fish were determined by the keys described by Uchida(1939) and Chung(1977).

In order to determine the distribution of encysted larvae of trematodes, one gram of flesh, 50 scales, all fins and tail were taken from each fish using a knife, compressed between two large slides (50x90mm) and examined for the presence of metacercariae of digenetic trematodes under a binocular dissecting microscope.

In order to isolate the larval trematodes and to estimate the average number of cysts per gram of flesh, the digestion technique was applied; one gram of the flesh, mixed with artificial gastric juice.

The juice consisted of 0.2 gram of diluted hydrochloric acid and 0.3 gram of pepsin per 100 ml of distilled water.

The beakers containing the mixture were incubated under the temperature 37-38℃ for 30-40 minutes.

The cysts obtained were studied morphologically for the determination of species following Komiya and Tajimi(1940 and 1941).

Results

The individual numbers of fresh-water fish and brackish-water fish caught in the two localities of the river Wyangpi are presented in Table 1.

Nine species of fish were collected in the river. Of these, the crussian carp(*Carassius carassius*), the bullhead(*Coreobagrus brevicorpus*), the striped shiner(*Pungtungia herzi*), the pale chub(*Zacco platy-*

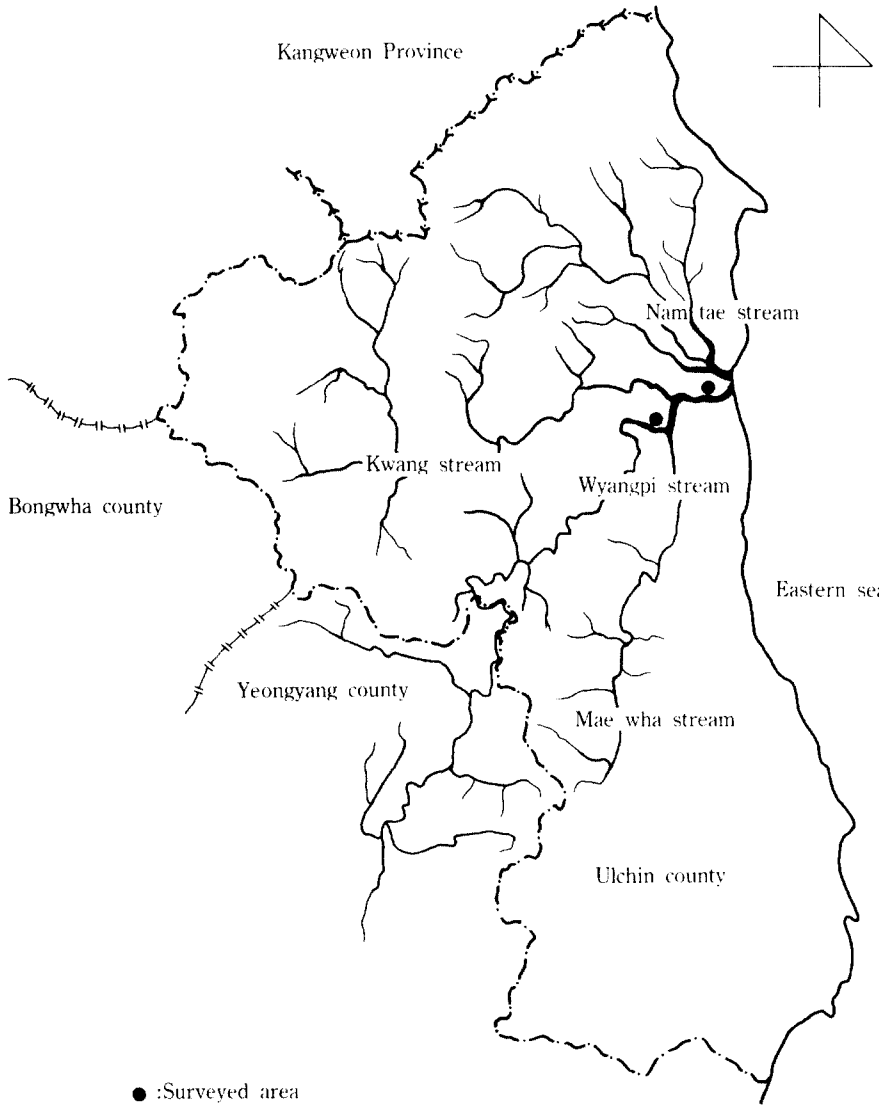

Fig. 1. Surveyed areas in the vicinity of the river Wyangpi, Kyungpook Province, Korea.

Table 1. Fresh-water fish and brackish-water fish caught in river Wyangpi, Kyungpook Province, Korea(1989)

Species	Common name	Korean	Lenght(Cm)	Weight(gram)	No. of fish examined
Carassius carassius Linnaeus	Crusian carp	붕어	6.0－17.0	4.0－ 67.2	62
Coreobagrus brevicorpus Mori	Bullhead	꼬치동자개	6.5－16.5	3.5－ 63.2	83
Coreoperca herzi Herzenstein	Perch	꺽지	6.5－15.0	4.5－ 50.5	14
Pungtungia herzi Herzenstein	Striped shiner	돌고기	8.0－13.5	4.5－ 20.9	62
Zacco platypus (T et S*)	Pale chub	피래미	8.0－14.0	6.0－ 31.0	63
Zacco temmincki (T et S)	Dark chub	갈겨이	8.0－14.0	4.0－ 22.2	98
Gasterosteus aculeatus aculeatus (Linnaeus)	Needle fish	큰가시고기	8.0－10.0	5.0－ 6.0	100
Mugil cephalus (Linnaeus)	Grey mullet	숭어	23.0－26.0	137.2－200.7	12
Plecoglossus altivelis (T et S)	Sweet fish	은어	8.5－19.0	4.5－ 50.0	54

*T et S; Temminck et Schlegel

Table 2. Infestation rates for encysted larvae of digenetic trematodes in flesh of fish(1989)

Species	No. of fish examined	C. *sinensis*		C. *orientalis*		*E.* species		*E. oviformis*		*M. yokogawai*		Unknown species	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Carassius carassius	62	—	—	—	—	—	—	—	—	—	—	—	—
Coreobagrus brevicorpus	83	—	—	—	—	—	—	—	—	—	—	—	—
Coreoperca herzi	14	—	—	—	—	—	—	—	—	—	—	—	—
Pungtungia herzi	62	1	1.6	—	—	2	3.2	—	—	—	—	3	4.8
Zacco platypus	63	—	—	—	—	8	12.7	2	3.2	5	7.9	—	—
Zacco temmincki	98	—	—	1	1.1	3	3.1	2	2.0	7	7.1	2	2.0
Gasterosteus aculeatus aculeatus	100	—	—	—	—	—	—	—	—	—	—	—	—
Mugil cephalus	12	—	—	—	—	—	—	—	—	—	—	—	—
Plecoglossus altivelis	54	—	—	1	1.9	—	—	—	—	29	53.7	2	3.7

Remark : *C. sinensis: Clonorchis sinensis*　*C. orientalis: Cyathocotyle orientalis*
E. Species : *Echinochasmus* species　*E. oviformis: Exorchis oviformis*
M. yokogawai: Metagonimus yokogawai
No.: Number infested

Table 3. Infestation density of larval trematodes in 4 kinds of fish(1989)

Species	No. of fish examined	Average No. of metacercaria per gram of flesh(ea)					
		C. sinensis	*C. orientalis*	*E.* species	*E. oviformis*	*M. yokogawai*	Unknown species
Pungtungia herzi	62	0.01	—	0.01	—	—	0.04
Zacco platypus	63	—	—	0.10	0.04	0.11	—
Zacco temmincki	98	—	0.03	0.02	0.03	0.11	0.01
Plecoglossus altivelis	54	—	0.01	—	—	4.17	0.03

Table 4. Infestation rates for encysted larvae of digenetic trematodes in scales and fins of fish(1989)

Species	No. of fish examined	*E. oviformis*		*M. hasegawai*		*M. yokogawai*		*M. orientalis*		Unknown species	
		No.	%	No.	%	No.	%	No.	%	No.	%
Carassius carassius	62	—	—	—	—	—	—	—	—	—	—
Coreobagrus brevicorpus	83	1	1.2	—	—	—	—	—	—	—	—
Coreoperca herzi	14	—	—	—	—	3	21.4	1	7.1	—	—
Pungtungia herzi	62	—	—	—	—	3	4.8	—	—	1	1.6
Zacco platypus	63	—	—	1	1.6	15	23.8	6	9.5	9	14.3
Zacco temmincki	98	2	2.0	—	—	43	43.9	1	1.0	—	—
Gasterosteus aculeatus aculeatus	100	—	—	—	—	—	—	—	—	—	—
Mugil cephalus	12	—	—	—	—	—	—	—	—	—	—
Plecoglossus altivelis	54	—	—	—	—	22	40.7	—	—	—	—

Remark : *E. oviformis: Exorchis oviformis*　*M. hasegawai: Metacercaria hasegawai*
M. yokogawai: Metagonimus yokogawai　*M. orientalis: Metorchis orientalis*

pus), the needle fish(*Gasterosteus aculeatus aculeatus*), and sweetfish(*Plecoglossus altivelis*) are the most frequently collected species of fish.

Two species, the perch(*Coreoperca herzi*) and the grey mullet(*Mugil cephalus*) are known to be the common fish of the river, but in the present survey they are less frequently collected.

Table 2 lists the infestation rates of encysted larvae of digenetic trematodes in flesh of fish caught in the river Wyangpi. Nine species of fish caught in the river were examined. Of these, four species were infected with the five kinds of metacercaria, *C. sinensis, C. orientalis, Echinochasmus* species, *E. oviformis,* and *M. yokogawai,* and 4 kinds of undetermined larvae.

Among the nine species of fish, the striped shiner was only infected with encysted larvae of *C. sinensis,* being found to be 1.8 per cent.

Of the three species of fish with *M. yokogawai,* the most frequently infected fish was the sweetfish, being found to be 53.7 per cent, followed by the pale chub, 10.6 per cent, and the dark chub, 7.4 per cent. Similarly, the cysts of *E. oviformis* were recovered from 3 species of fish. The cysts were found in the flesh, ranging in frequency from 1.9 per cent to 4.3 per cent.

The intensity of infestation with the larval trematodes in 4 kinds of fish is listed in Table 3. The metacercarial density of larval trematodes in fish, however, expressed in average number of cysts per gram of flesh, appeared to be lower in fish caught in the river Wyangpi.

In the intensity of infestation with the cysts, the striped shiner was infected with a few cysts of *C. sinensis* and the average number of larvae was 0.01.

In the case of *M. yokogawai,* the density of the cysts in the flesh was somewhat higher than that of *C. sinensis.* The brackish-water fish, the sweetfish was somewhat heavily infected with the larvae and the average number of cysts was 4.17. However, the fresh-water fish, the pale chub and the dark chub, were less heavily infected with the larvae than the sweetfish, with an average of 0.11.

In the case of *C. orientalis, Echinochasmus* species, and *E. oviformis,* the intensity of infestation with cysts were very low and the average of encysted larvae varied by fish species form 0.01 to 0.1.

The data presented in Table 4 are the infestation rates for encysted larvae of digenetic trematodes on the scales, fins and tail of fish.

Four kinds of larval trematodes, *E. oviformis, M. hasegawai, M. yokogawai,* and *M. orientalis* were found, and of these, *M. yokogawai* was found from 5 species of fish, ranging in frequency from 4.8 per cent to 43.9 per cent. *M. orientalis* cysts were found from 3 species and *M. hasegawai* cysts was found in only one species, *Zacco platypus.*

Discussion

The most important finding in this study is that the infestation rates for encysted larvae in fresh-water fish and brackish-water fish collected at two localities of river Wyangpi varied appreciably from fish to fish, and the degree of infestation with the cysts was relatively low as compared with earlier reports available.

The river Wyangpi is located in the hilly and mountainous district of the northeast part of Kyungpook Province, and is famous for its mysterious deep valley which has clear water and various kinds of seasonal flowers.

In this basin, there is one of the natural Monument(No. 155) in Korea, Ulchin Seongnyugul which is the oldest cave in the Orient and is full of exotic stalactites and stalagmites.

According to local officials in the vicinity of the river Wyangpi, rural and urban people often visit these clear waters and/or Ulchin Seongnyugul cave on weekends or holidays, and the majority of them enjoy fishing and also consuming the raw fish.

They are not concerned about infection with intestinal and/or hepatic flukes, but believe that fresh-water fish and brackish-water fish collected in this basin are completely free of larval trematodes because the river is clear and running over pebbles and rocky bottoms, and so are easily persuaded to enjoy the delicious taste of the flesh,

mainly of the sweetfish. However, this traditional concept is found to be false by the results obtained by this study. The results in this study showed that 53.7 per cent of 54 sweetfish caught in the river Wyangpi were infected with the encysted larvae *M. yokogawai* and the intensity of infestation with the larvae was 4.17.

In the studies of fish intermediate hosts infected with larval trematodes in the vicinity of major rivers and their tributaries running into the eastern Sea of Korea, Hwang and Choi(1977) conducted metacercarial densities of *M. yokogawai* in *P. altivelis* in Kyungpook Province, and reported that all the sweetfish caught in the river Oseep were infected with the cysts of *M. yokogawai* and the intensity of infection with the larvae was extraordinary high, being found to be 4,333 per fish, and Lee at al. (1979) in their study of the larval trematodes from fresh-water fish at the same river, collected the eight species of fresh-water fish and the two kinds of brackish-water fish and found that they were infected with 10 species of larval trematodes including 3 undetermined larvae A, B and C.

Of the larvae recovered, *M. yokogawai* cysts were found from seven fish examined, and *C. sinensis* larvae were found from 2 kinds of fish, the white fish and the Korean shiner. They also reported that the rate and intensity of infection with the larval trematodes varied markedly from fish to fish.

Similar results were obtained by Roh(1980), Joo and Park(1982), Song and Jeon(1983), Joo et al. (1984), Joo(1984), Yoo et al.(1984), Ahn(1984), and Ahn et al.(1984). In these studies, the sweetfish collected in the rivers running into the eastern Sea of Korea were infected with the encysted larvae of *M. yokogawai* and the degree of infestation with the larvae was very high.

In this study, seven species of fresh-water fish and two species of brackish-water fish were collected, from which 9 kinds of larval trematodes including 4 kinds of undetermined larvae were found.

Of the fish examined, the pale chub, the dark chub, and the sweetfish harboured the cysts of *M. yokogawai* the infection rate for *Metagonimus* larvae in fish were lower than that reported by Joo et al.(1983) in the river Taechong, by Joo(1984) in the river Hyungsan, and by Joo(1988) in the river Taewha.

However, the average number of encysted larvae of *M. yokogawai* per gram of flesh was very low, being found to be from 0.11 in *Z. platypus* to 4.17 in *P. altivelis*.

In the present study, no infections were found in 5 species, the crusian carp, the bullhead, the perch, the needle fish, and the grey mullet, represented in the collections, although large numbers were examined.

One of the factors influencing the infection of larval trematodes in fish were considered to be the pesticidal and artificial effects on the water, which are inhibitory on the survival of larval trematodes, and can enhance destruction of natural environment and ecology of the river. As another factor, the ecology of fish is to be taken into account. A study of Sakai(1954) reported that the infection rate was very low in *Gnathopogon* species living at the bottom of lake and river during the summer time, while that in *Ishikausia steenackeri* and *Carassius auratus* living in the shallow part of the shore of the lake and river was very high.

The third factor is concerned with the habitat of the snail host which lives in water areas as deep as one metre and not so deep as 8 metres.

In the fourth place, the relation to the incidence of intestinal and/or hepatic flukes among mammals including human beings will be noticed.

Ha and Joo(1987) conducted a survey on the incidence of intestinal parasites among residents in the vicinity of the river Wyangpi in Ulchin county, by stool examination, and reported that the infection rate for *M. yokogawai* was found to be 1.1 per cent in 819 residents and *C. sinensis* in positive rate, 0.7 per cent.

The findings obtained by Ha and Joo(1987) were lower than the infection rate of 18.8 per cent reported by the Chung and Choi in an investigation of the basin of Oseep in the year 1979.

Of the fish examined, only one species, *Pungtu-*

ngia herzi, harboured the metacercaria of *C. sinensis* in this study and the infection rate was 1.8 per cent. Little factual data can be found related to the infection status for the encysted larvae of *C. sinensis* in fish intermediate hosts in the vicinity of the rivers running into the eastern Sea of Korea.

Lee et al.(1979) conducted a survey on the larval trematodes from freshwater fish in the river Oseep, and reported that only two species among the species, the white fish and the Korean shiner, harboured the metacercariae of *C. sinensis*.

A study of Joo et al.(1983) reported that seven species of fish could be collected in the river Taechong, but no fish species with *Clonorchis* cysts were found. After that, Joo(1984) carried out a study on infestation of larval trematodes from fresh-water fish and brackish-water fish in the river Hyungsan, and found the larvae of *C. sinensis* from 4 kinds of fish examined. He also comented that *C. sinensis* and *M. yokogawai* infections among residents might occur by consuming raw fish collected in the river Hyungsan.

The results in the present study are similar to those reported by Lee et al.(1979), Joo et al.(1983), and Joo(1984), but much lower in the infestation rates for the metacercarial larvae of *C. sinensis* among fish examined. Of the larval trematodes recovered in this study, the *E. oviformis* cyst was found 4 species of fish examined, and *Echinochasmus* species larvae from the flesh of 3 species, but *M. orientalis* cyst was found from scales and fins of 3 species.

The rate and intensity of infestation with the larval trematodes varied markedly from fish to fish, and was similar to the data reported by Lee et al.(1979), and Joo et al.(1983).

Although the high infestation of the larval trematodes from fish hosts in the vicinity of the major rivers and their tributaries in Korea have been reported by many investigators, the results obtained in this study suggest that larval trematodes from the fish hosts in the basin of Wyangpi is less infested than in the other areas of Kyungpook Province.

Summary

A study of infestation patterns for digenetic larval trematodes from fresh-water fish and brackish-water fish caught in river Wyangpi running through Ulchin county, Kyungpook Province was carried out during the period from April to October in 1989.

They were collected by netting, fishing with rod and line, and were dissected into the flesh, scales and fins with tail, and then examined for the presence and infection density of larval trematodes.

Of the 9 kinds of fish examined, the encysted larvae of *Clonorchis sinensis* were found from 1 kind of them, *Echinochasmus* species and *Metagonimus yokogawai* from 3 kinds, and *Exorchis oviformis* and *Cyatocotyle orientalis* from 2 kinds in the present study, and infestation rate for encysted larvae varied appreciably from fish to fish.

In the intensity of infestation with *Clonorchis sinensis*, the striped shiner, *Pungtungia herzi*, was infected with a few cysts and the average number of larvae was 0.01. In the case of *Metagonimus yokogawai*, the sweetfish, *Plecoglossus altivelis*, was somewhat heavily infected with the larvae and the average number of cysts was 4.17. In comparison, the fresh-water fish were less heavily infected and the average number of cysts per gram of flesh in the pale chub and the dark chub was 0.11.

The results of this study generally indicate that although the low infestation of larval trematodes from fish hosts in the river Wyangpi, *Clonorchis sinensis* and *Metagonimus yokogawai* infections may occur by consuming raw fresh-water fish and brackish-water fish caught in the river Wyangpi, Kyungpook Province, Korea.

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