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# *Radix auricularia coreana*: Natural snail host of *Clinostomum complanatum* in Korea

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**Abstract:** An epidemiological survey was carried out to determine the first intermediate host of *Clinostomum complanatum* among freshwater snails in Korea. Two species of snails belonging to the family Lymnaeidae were collected in Kaum-ji (pond), Uisong-gun, Kyongsangbuk-do. Twelve (0.9%) out of 1,273 *Radix auricularia coreana* examined were found to liberate cercariae of *C. complanatum*, which were identified by morphological characteristics and experimental infections in freshwater fish, *Pseudorasbora parva*. The cercariae were brevifurcate and clinostomatoid. They had a transparent dorsal fin, a well developed penetrating organ and a pair of eye spots. The body measured 119-147 × 33-36 μm, tail stem, 275-370 × 19-26 μm, and furcae, 72-104 μm. Rediae were demonstrated in the infected snail after crushing. Redia, 527-1,630 μm long and 121-368 μm wide, contained 10-45 germ balls and cercariae in various developmental stages. The metacercariae recovered from fish experimentally infected with *C. complanatum* cercariae were morphologically identical to those from naturally infected fish.

**Key words:** *Radix auricularia coreana*, the first intermediate host, *Clinostomum complanatum*, cercariae, rediae

## INTRODUCTION

*Clinostomum complanatum* (Rudolphi, 1814) is a zoonotic parasite in Asia where people used to consume raw fish (Witenberg, 1944; Cameron, 1945; Kifune and Kousaka, 1996). *Clinostomum* spp. parasitizes the oral cavity or pharynx of piscivorous birds (Yamaguti, 1958) and accidentally infects human to cause pharyngitis. In Korea, a human case of *Clinostomum* pharyngitis was recently reported (Chung *et al.*, 1995b).

Many freshwater fishes play a role as the source of the human infection by *C. complanatum* throughout the world. Twelve species of the freshwater fishes were recorded as the second intermediate hosts in Korea (Chung *et al.*, 1995a). Three species of freshwater snails, *Lymnaea auricularia swinhoei*, *L. stagnalis* and *Radix ovata*, have been reported as the first intermediate hosts of *C. complanatum* in Poland (Grabda-Kazubska, 1974) and Taiwan (Lo *et al.*, 1982). *Lymnaea japonica* and *L. ollula* were reported as the experimental snail hosts in Japan (Aohagi *et al.*, 1993). These five species of snails all belong to the family Lymnaeidae. Korean rivers and ponds are abundunt with the snails of this family. However, the snail host of *C. complanatum* has not been identified in Korea.

In the present study, we examined snails of the family Lymnaeidae and confirmed *Radix auricularia coreana* as the first intermediate

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host of *C. complanatum* in Korea. The morphological features and measurements of rediae and cercariae of this trematode are also discribed.

## MATERIALS AND METHODS

Two species of freshwater snails were collected in Kaum-ji (pond), Uisong-gun, Kyongsangbuk-do (Fig. 1) which had been confirmed as an enzootic focus of *C. complanatum* (Chung *et al.*, 1995a). The snails were identified as *R. auricularia coreana* (Fig. 2) and *Austropeplea ollula* according to the keys described by Kwon *et al.* (1993). Each snail was placed into a well of 6- or 12-well culture plates for 3 days. The cercariae shed from *Radix* snails were studied morphologically. Some cercariae were fixed in 10% hot formalin for measurements. Some snails infected with *C. complanatum* larvae were crushed for collection and examination of rediae. Other snails were placed into an aquarium for experimental infection in freshwater fish, *Pseudorasbora parva* caught at Dongmyong-ji (pond) which is not an enzootic area of *C. complanatum*. Two hundred of *P. parva* were examined and confirmed the absence of *C. complanatum* or other metacercaria. Ten fishes were used in the experimental infection.

Ten months after experimental infection, the fish were sacrificed for recovery of the metacercariae. The metacercariae recovered were fixed and stained, and morphological features studied.

**Fig. 2.** The freshwater snails, *Radix auricularia coreana*, collected from Kaum-ji.

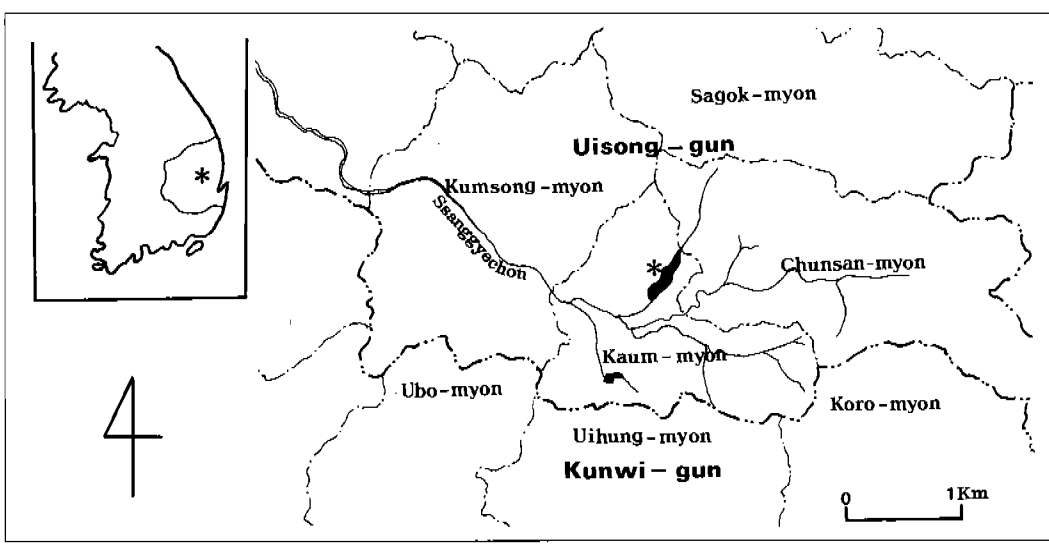


**Fig. 1.** The map showing the surveyed area of Kaum-ji (pond), Uisong-gun, Kyungsangbuk-do, Korea. An asterisk ( * ) denotes the surveyed area.

## RESULTS

Cercariae of *C. complanatum* emerged from 12 (0.9%) out of 1,273 *R. auricularia coreana* whereas no *C. complanatum* larvae were demonstrated from 268 *A. ollula* snails (Table 1). Cercariae other than those of *C. complanatum* emerged from both snails (data not shown).

The morphological features and measurements of *C. complanatum* cercariae shed from *R. auricularia coreana* are as follows:

The cercariae were brevifurcate and clinostomatoid (Fig. 3A). Total length of cercariae measured 492-542 μm (Table 2). The body measured 119-147 × 33-36 μm. The tail stem measured 275-370 × 19-26 μm and furca was 72-104 μm long. The body had a longitudinal transparent dorsal fin (Fig. 3B) and was covered with minute spines. The penetrating organ was well developed, located at the anterior terminal and measured 33-41 × 21-26 μm (Fig. 3C). The mouth opening was located ventrally behind the penetrating organ (Fig 3B). A pair of eye spots was located in the anterior part of middle one third of the body and measured 4.4-6.2 μm (Fig. 3B). The excretory bladder was located at posterior end of the body. The caudal excretory canal ran posteriorly along the tail stem and furcae and opened at the end of each furca (Fig. 3D).

Redia, irregular in shape, contained 10-45 germ balls and cercariae in various developmental stages (Fig. 4) and measured 527-1,630 × 121-368 μm. The pharynx, anteriorly subterminal, measured 33-60 × 39-71 μm. The intestine extended posteriorly and measured 425-1,264 μm. The birth pore was located laterally beneath the pharynx.

Metacercariae recovered from experimentally infected fish were morphologically identical to

**Table 1.** Measurements of *Clinostomum complanatum* cercariae (in μm)

| | | Present authors | Aohagi *et al.* (1993) | Aohagi *et al.* (1993) | Lo *et al.* (1982) |
|---|---|---|---|---|---|
| Total | L[a] | 492-542 (521) | 497-549 (516) | 479-546 (510) | 528 |
| Body | L | 119-147 (127) | 104-124 (114) | 110-122 (116) | 132 |
| | W[b] | 33-36 (34) | 35-40 (36) | 32-38 (34) | 33 |
| Tail stem | L | 275-370 (320) | 294-319 (304) | 277-319 (298) | 195-360 |
| | W | 19-26 (23) | 21-27 (24) | 22-27 (24) | 13-20 |
| Furca | L | 72-104 (85) | 76-107 (93) | 76-107 (94) | 60-100 |
| Penetration | L | 33-41 (37) | 35-43 (40) | 35-44 (39) | 27 |
| organ | W | 21-26 (23) | 22-26 (24) | 19-25 (21) | 20.5 |
| Eye spot | | 4.4-6.2 (5.1) | 4.5-6.3 (5.3) | 4.5-6.3 (5.3) | 5.1 |
| Snail host | | *Radix auricularia coreana* | *Lymnaea japonica* | *L. ollula* | *R. ovata* |

[a]Length; [b]Width.

**Table 2.** Measurement of *Clinostomum complanatum* rediae (in μm)

| | | Present authors | Aohagi *et al.* (1993) | Aohagi *et al.* (1993) | Lo *et al.* (1982) |
|---|---|---|---|---|---|
| Body | L[a] | 527-1,630 (1,084) | 378-1,497 (778) | 384-889 (641) | 1,100 |
| | W[b] | 121-368 (219) | 146-311 (204) | 102-218 (161) | 116 |
| Pharynx | L | 33-60 (47) | 32-56 (42) | 28-60 (38) | |
| | W | 39-71 (50) | 37-66 (46) | 26-76 (42) | |
| Intestine | | 425-1,264 (766) | 351-1,141 (728) | 184-816 (590) | |
| Snail host | | *R. auricularia coreana* | *L. japonica* | *L. ollula* | *R. ovata* |

[a]Length; [b]Width.

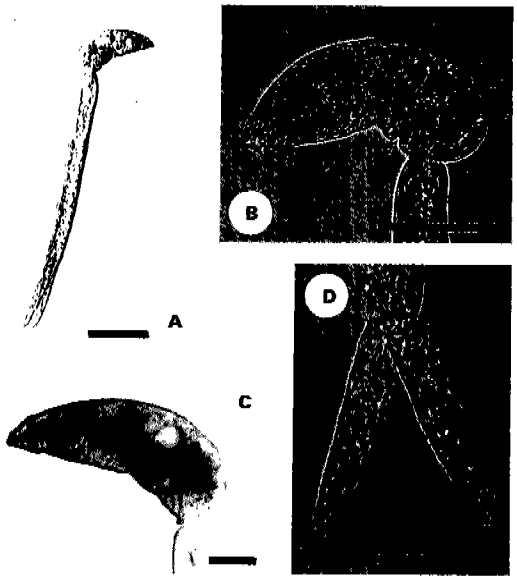


**Fig. 3.** A cercaria of *Clinostomum complanatum* from *Radix auricularia coreana*. **A.** Brevifurcate cercaria. Bar = 100 μm. **B.** The cercaria had a pair of eye spots, a translucent dorsal fin (arrows), mouth opening (filled arrow head) beyond the penetrating organ and ventral sucker analogue (blanked arrow head). Bar = 50 μm. **C.** The penetrating organ was well developed. Bar = 20 μm. **D.** Excretory pores (arrows) on the furcae. Bar = 50 μm.

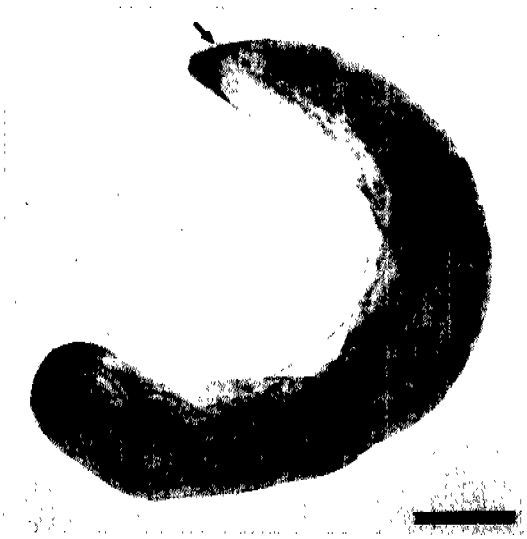

**Fig. 4.** A redia from infected *Radix auricularia coreana*. It contained many germ balls and cercariae in various developmental stages. The birth pore (arrow) was observed beyond the mouth. Bar = 200 μm.

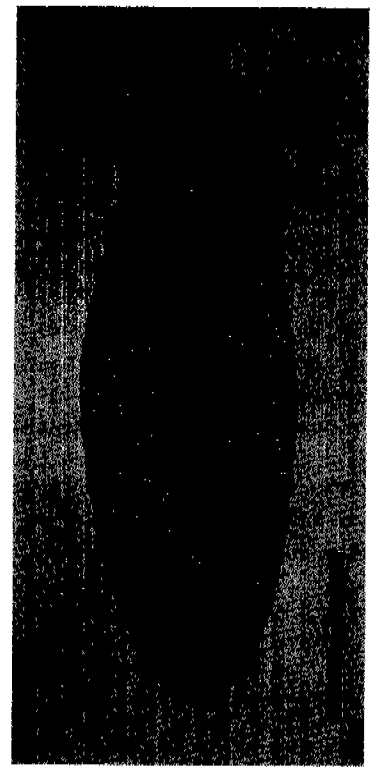

**Fig. 5.** A metacercaria of *Clinostomum complanatum* from experimentally infected *Pseudorasbora parva*. Bar = 1 μm.

those from naturally infected fish (Fig. 5).

## DISCUSSION

We have determined *R. auricularia coreana* to be the natural snail intermediate host of *C. complanatum* in Korea and described detailed morphological features of the trematode larvae, cercariae and rediae. The morphological features and measurements of the cercariae and rediae corresponded with the description of Lo *et al.* (1982) and Aohagi *et al.* (1993). The pharyngeal structure was not observed in this study. This observation coincides with that of Aohagi *et al.* (1993) who regarded *C. complanatum* cercariae as members of the apharyngeal group. However, the long hairs on the tail stem and furcae which were mentioned by Aohagi *et al.* (1993) were unclear in their numbers in this study. Further studies using a scanning electron microscope should clarify the exact number

and location of the sensory hairs.

More germ balls and cercariae were found in rediae in the present study than rediae in the report by Aohagi *et al.* (1993). The difference in the number of germ balls and cercariae in a rediae may result partly from the difference of host snails. We obtained rediae from naturally infected *R. auricularia coreana* whereas Aohagi *et al.* (1993) reported on rediae from experimentally infected *L. japonica* and *L. ollula*.

We failed to demonstrate *C. complanatum* larvae from *A. ollula*, which has the same habitat as *R. auricularia coreana*. However we cannot rule out the possibility of *A. ollula* as a host of *C. complanatum*, because the number of the snails examined in this study was insufficient. From the present study, *R. auricularia coreana* is newly recorded as a natural snail host of *C. complanatum*.

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=초록=

# 물달팽이 (*Radix auricularia coreana*): 한국에서 새인두흡충의 제1중간숙주

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한국산 담수 패류에서 새인두흡충의 제1중간숙주를 밝히기 위해 경상북도 의성군 소재 가음지에서 Lymnaeidae과에 속하는 두 종류의 담수패류, 물달팽이 (*Radix auricularia coreana*) 및 애기물달팽이 (*Austropeplea ollula*)를 채집하여 조사하였다. 물달팽이 1,273개 중 12개에서 새인두흡충 유미유충이 유출되었다. 새인두흡충 유미유충은 brevifurcate이고, clinostomatoid 하였으며, 투명한 dorsal fin, 체전단에 잘 발달된 침입기구, 그리고 체중앙부에 한쌍의 안점을 가지고 있었다. 몸의 크기는 119-147 × 33-36 μm였고, tail stem은 275-370 × 19-26 μm, 그리고 furcae는 72-104 μm였다. 새인두흡충 유충에 감염된 물달팽이를 파각하여 redia를 확인하였으며, 그 크기는 527-1,630 × 121-368 μm였고, 안에 10-45개의 germ ball과 다양한 발육상태의 유미유충을 가지고 있었다. 새인두흡충 유미유충을 실험적으로 감염시킨 참붕어에서 얻은 피낭유충은 자연 감염에 의한 피낭유충과 동일한 형태학적 특징을 나타내었다.

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