

Recovery of *Pseudoterranova decipiens* (Anisakidae) larvae from codfish of the Antarctic Ocean

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Abstract: Anisakid larvae were found from the liver and stomach of the codfish (*Notothenia neglecta*) caught from the Antarctic Ocean, South Pole, where the Polar Research Center of The Korea Ocean Research and Development Institute is operating. Through observations by scanning electron (SEM) and light microscopy (LM), they were identified as the third stage larvae of *Pseudoterranova decipiens*, a potential agent of human codworm anisakiasis. They measured 25.0-28.5 mm in length, and 0.6-0.8 mm in width. The SEM revealed a prominent boring tooth, three lips, and excretory pore at the anterior end, and a small but prominent mucron at the posterior end. From whole mounts and cross sections of the larvae the ventriculus, intestinal cecum and a Renette cell were found characteristically at the same plane. Raw eating of the codfish caught from the Antarctic Ocean near the South Pole should be avoided so as to prevent human codworm anisakiasis in this area.

Key words: *Pseudoterranova decipiens*, codfish (*Notothenia neglecta*), SEM, Antarctic Ocean, South Pole

Pseudoterranova decipiens, the seal nematode, has been found from many sea areas of the world (Bristow and Berland, 1992). Their larvae, known as the codworm or sealworm, have also been reported from more than 30 marine fish species (Bristow and Berland, 1992). Codworms are abundant in coldwater fish such as the cod, pollock, hahbut, flatfish, etc. (Oshima, 1987). Among them, the cod is regarded as having the most number of *P. decipiens* (Oshima, 1987). The infection by the larvae of *P. decipiens* is recently called as pseudoterranoviasis or codworm anisakiasis (Ishikura and Namiki,

1989; Chai, 1990). In Korea, six human cases were confirmed as infection by *Pseudoterranova* type A larva (Seo *et al.*, 1984; Lee *et al.*, 1985; Im *et al.*, 1990; Im and Shin, 1991), and a case infected by the larva of *P. decipiens* (Sohn & Seol, 1994). However, the larvae have never been recovered or described from the fish host.

The Polar Research Center of The Korea Ocean Research and Development Institute is located near the South Pole. Many members of this camp used to eat raw codfish caught from the Antarctic Ocean unwaring the danger of codworm anisakiasis. In the present study, we examined the codfish of the Antarctic Ocean whether they were infected by codworms, and the characteristic morphology of the larvae of *P. decipiens* is briefly described.

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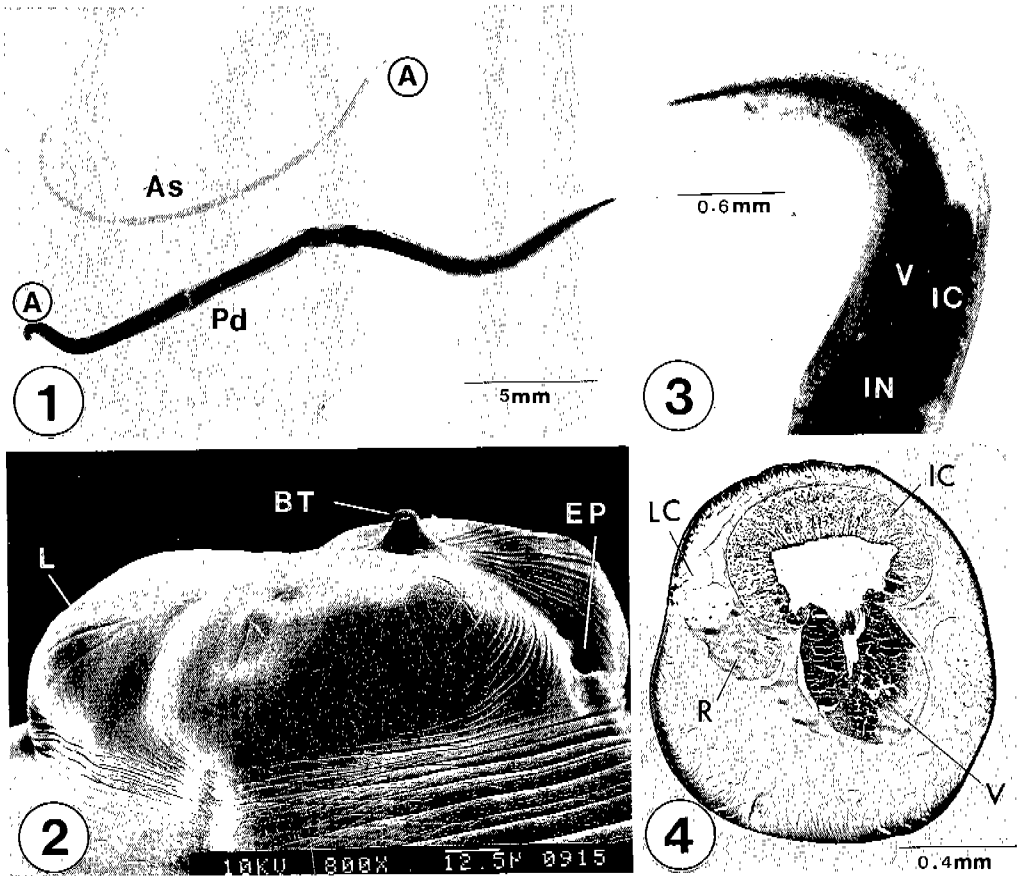


Fig. 1. A comparative view of *Anisakis simplex* (As) (Chai *et al.*, 1992) and *Pseudoterranova decipiens* (Pd) larvae (this study). A: anterior end. **Fig. 2.** SEM view of the anterior end of the larva (A of Pd, Fig. 1) showing 3 lips (L), a prominent boring tooth (BT) and an excretory pore (EP). **Fig. 3.** LM view of the anterior part of a *P. decipiens* larva showing the ventriculus (V), intestinal cecum (IC) and intestine (IN). **Fig. 4.** A cross section at the anterior part of the ventriculus/intestinal cecum level. The ventriculus (V), intestinal cecum (IC) and Renette cell (R) were simultaneously sectioned. LC: lateral cord. H-E stain.

Total five codfish (*Notothenia neglecta*), 37-39 cm in length, caught from the South Pole were examined for the presence of nematode larvae. More than 30 larvae of *P. decipiens*, were discovered from the liver and stomach of the fish. No other kinds of anisakids were recovered. Other parts of the fish were not examined because of lack of facility at the camp station. Several larvae were fixed in 2.5% glutaraldehyde for scanning electron microscopy (SEM). Others were fixed in 10% formalin and cross sectioned for light microscopic (LM) observation. Several fixed worms were cleared in lactophenol, whole-mounted, and observed.

The larvae were 25.0-28.5 mm in length, and

0.6-0.8 mm in width (Fig. 1). They were bigger, stouter, and darker in color compared with the third stage larvae of *Anisakis simplex* collected from the sea eel in Korea (Chai *et al.*, 1992) (Fig. 1). In SEM observations of the anterior end of the larvae, a prominent boring tooth was observed directing outward at the anterior extremity (Fig. 2). The larvae had three low lip bulges which were distinctive and well demarcated. These lips were equal in size and shape. The base of the lip bulges exhibited some structures resembling papillae, but higher magnification revealed them as swellings of the base. Between the bases of the lip bulge located the excretory pore (Fig. 2).

The LM observations on whole mounts

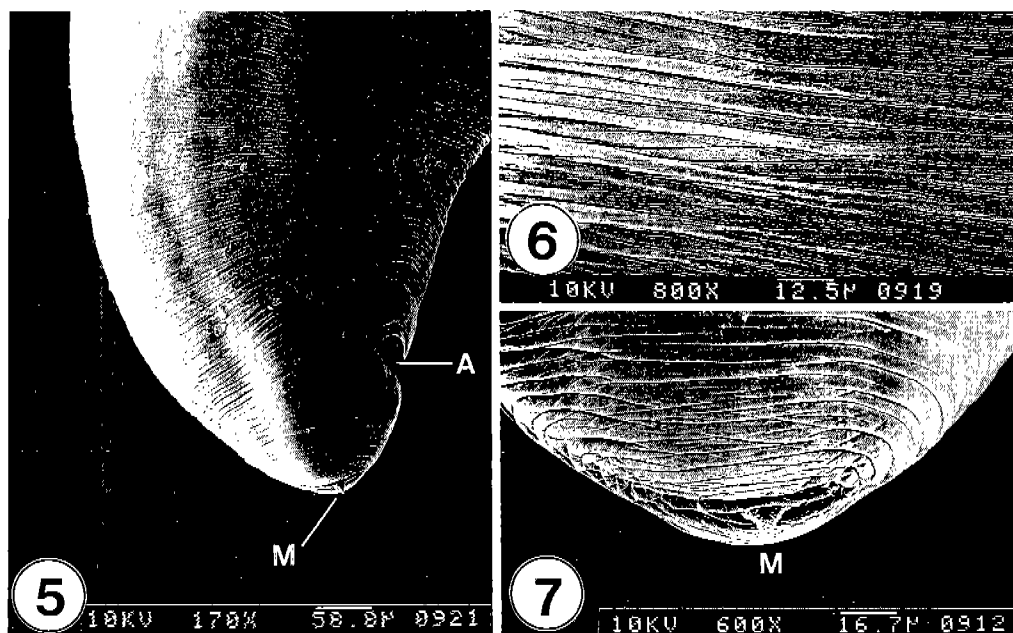


Fig. 5. SEM view of the posterior part of a *P. decipiens* larva. The anus (A) and a small but prominent mucron (M) are seen. **Fig. 6.** Magnification of the cuticle of a larva showing transverse striations. **Fig. 7.** Magnification of the terminal area of the larva showing transverse striations and a prominent mucron (M).

showed that a Renette cell is situated from the level of the nerve ring to the anterior half of the intestine. The ventriculus and intestinal cecum were present (Fig. 3). The morphology of the cross section at 1/6-1/8 level of the anterior part was as follows. The epidermal layer was present, and the muscle layer consisted of polymyarian muscle cells. The ventriculus, intestinal cecum and a Renette cell were simultaneously sectioned at the same plane (Fig. 4).

In SEM observations of the posterior part of the larvae, the transverse striations of the cuticle gradually became wider and the intervals between them became even (Figs. 5 & 6). The cone-shaped posterior extremity had the anus and a small but prominent mucron (Figs. 5 & 7).

Identification of the anisakid larvae is made on the basis of their esophagointestinal morphology and measurements. The larvae of *Anisakis simplex* (= *Anisakis* type I larvae) have only the ventriculus and a Renette cell at 1/6-1/8 level of the anterior part (Koyama *et al.*, 1969). *P. decipiens* larvae are distinguished

from *Anisakis* spp. or *Contracaecum* spp. larvae by the presence of an intestinal cecum but no ventricular appendage. The SEM and LM features of our specimens were well corresponded to the larvae of *P. decipiens* (Koyama *et al.*, 1969; Ishii *et al.*, 1989).

According to the proposed life cycle of *P. decipiens*, the eggs liberated from the seal host are ingested by cyclopoid copepods, and then these copepods are eaten by a codfish (Bristow and Berland, 1992). The codworm occurs primarily in the muscle of the fish, and very few worms are found in the viscera (Oshima, 1987). Although we were unable to examine the rest parts of the codfish other than the viscera, there should have been many larvae in the muscle or other tissues. If people consume raw fillet or viscera of the codfish infected with *P. decipiens* larvae, human infection may occur. In humans, the codworms predominantly cause gastric anisakiasis rather than intestinal type (Ishikura and Namiki, 1989).

In the present study it was confirmed that the codfish of the Antarctic Ocean, South Pole, were infected with the larvae of *P. decipiens*,

and raw eating of the flesh or viscera of the codfish should be avoided so as to prevent human codworm anisakiasis in this camp area.

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=초록=

남극해산 대구에서 물개회충(*Pseudoterranova decipiens*) 유충의 검출

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한국해양연구소의 극지연구센터가 운영되고 있는 남극 기지 부근 남극해에서 대구(*Notothernia neglecta*)를 잡아 조사한 결과 위와 간에서 선충류 유충이 발견되었다. 광학현미경 및 전자현미경적 관찰 결과 이들은 인체에 codworm anisakiasis를 일으킬 수 있는 물개회충(*Pseudoterranova decipiens*)의 제3기 유충으로 동정되었다. 유충의 길이는 25.0-28.5 mm였고, 폭은 0.6-0.8 mm였다. 주사전자현미경 소견상 충체 앞부분에서 boring tooth가 뚜렷이 관찰되었고, 3개의 입술과 배설공이 존재하였다. 충체 끝부분에는 작지만 뚜렷한 mucron 1개가 관찰되었다. 충체 단면의 광학현미경적 소견에서는 ventriculus의 전방 부위에서 특징적으로 ventriculus, intestinal caecum 및 Renette cell이 동시에 절단되어 있는 것이 관찰되었다. 이상의 결과를 통해 남극해산 대구가 물개회충의 제3기 유충에 감염되어 있음을 확인할 수 있었으며, 남극해산 대구를 날로 먹을 경우 codworm anisakiasis를 유발할 수 있으므로 주의가 요망되었다.

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