

## Identification of *Acanthocephala* discovered in changran-pickles and myungran-pickles

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To identify acanthocephala found in ‘Changran-pickles’ and ‘Myungran-pickles’ each organ was measured in permanent slides. In the present report, the results obtained were as follows: 1. Morphology of male worms: Worms possessed 18-19 longitudinal rows, with 4 hooks per row, which became smaller towards the base of proboscis. Each worm contained two testis and six cement glands arranged linearly. Body 22.0 by 0.8-0.6 mm and 15.0 by 0.6-0.4 mm, proboscis 284.8 by 227.6 µm and 524.9 by 151.4 µm, proboscis sheath 1570.7 by 72.7 µm and 751.9 by 280.4 µm, lemnisci length 2566.7 and 1085.6, testis 2202.9-1860.5 by 737.0-575.7 µm and 1033.8-981.1 by 463.1-351.6 µm, cement glands 940.2 by 441.2 µm and 610.0 by 369.1 µm. 2. Morphology of female worms: Worms possessed 14-18 longitudinal rows, with 6-10 hooks per row and become smaller toward the base of proboscis. Each worm contained an uterine bell and uterus in the posterior portion and the eggs filled the body cavity. Body 14.0~51.0 mm by 0.7-0.5~2.2-1.4 mm, proboscis 466.1-268.9 µm by 259.9-252.0 µm, proboscis sheath 1550.7-506.0 by 298.8-231.1 µm, lemnisci length 1325.7-473.1 µm, eggs 112.4 by 28.5 µm~51.7 by 14.0 µm. In this present study, the acanthocephala collected in ‘Changran-pickles’ and ‘Myungran-pickles’ were identified as *Echinorhynchus gadi* by morphological features.

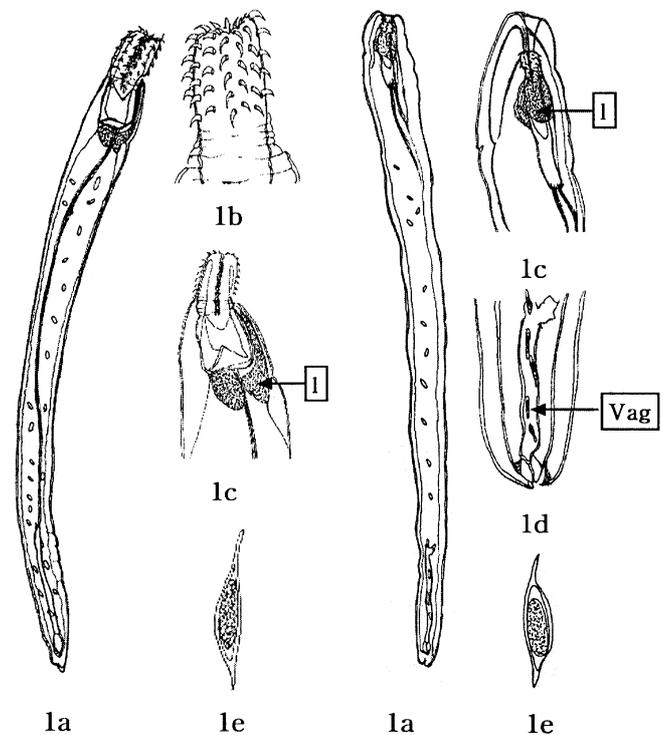
**Key words:** *Echinorhynchus gadi*, acanthocephala, hooks, proboscis, lemnisci, proboscis sheath, morphology

### Introduction

*Echinorhynchus gadi* Zoega in Muller, 1776 is the most common acanthocephalan which infects marine fish in the

North Atlantic and North Pacific oceans [5], and is found in more than 60 species of fish [1,6]. The sex of adult *Echinorhynchus gadi* is clearly distinguishable. The acanthocephalan group has an invaginable proboscis armed with many hooks that are arranged either transversely or longitudinally [2]. The trunk is cylindrical and has a smooth surface, and they are similar to the Nematoda in appearance [8].

Whitefield [10] reported upon an electron microscopical study on the ultrastructure of the sperm of *Polymorphus minutus*, David [4] reported that *Aeginina longicornis* is an

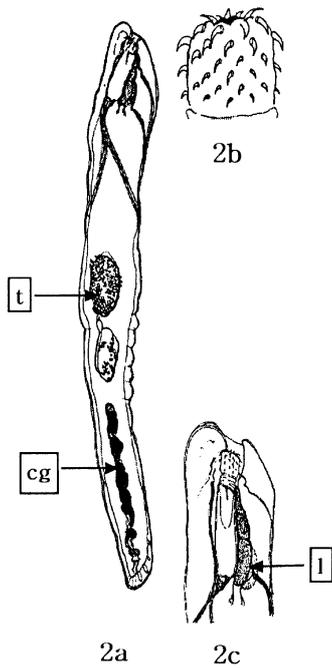


**Fig. 1.** Structure of female worms (a) whole body, (b) proboscis with hooks, (c) anterior, (d) posterior, (e) egg (l, lemniscis; Vag, vagina).

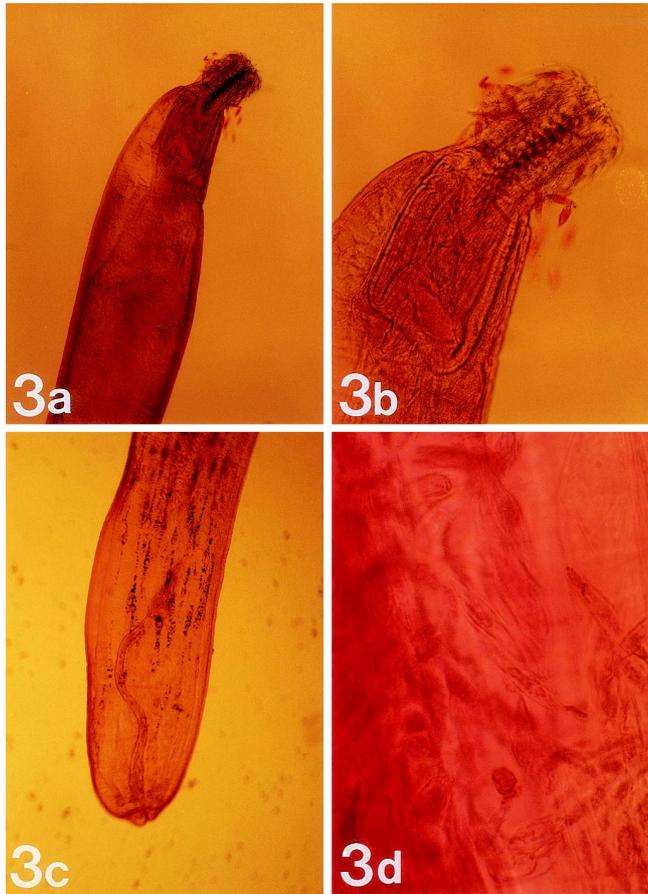
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**Fig. 2.** Structure of male worm (a) whole body, (b) proboscis with hooks, (c) anterior (cg, cement gland; l, lemniscis; t, testis).



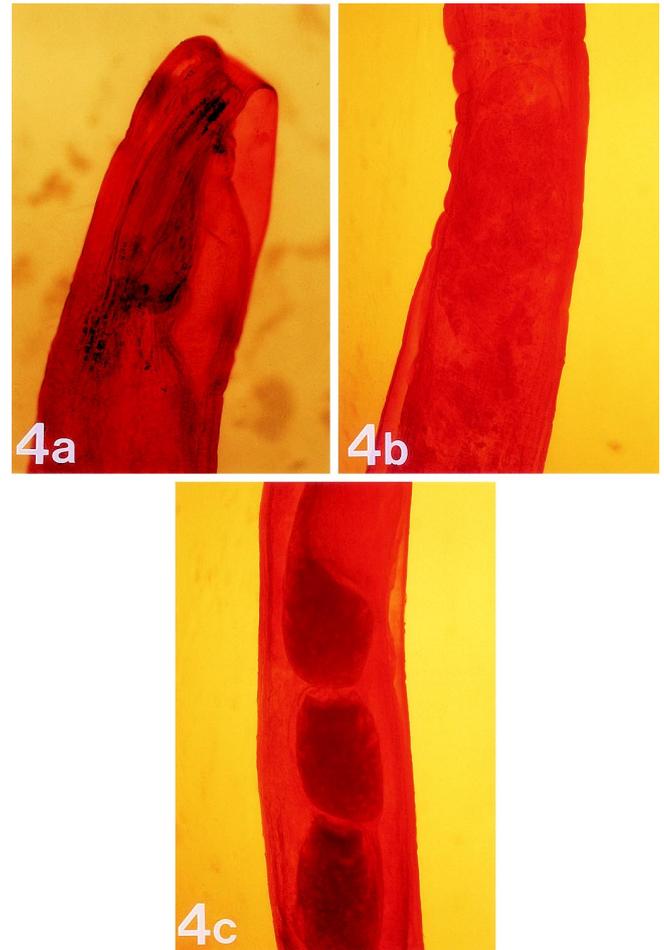
**Fig. 3.** Structure of female worms (a) anterior, (b) proboscis with hooks, (c) posterior, (d) eggs.

intermediate host of *E. gadi*. Chu [3] and Cho [2] reported upon the distribution of glycogen, mucopolysaccharides, lipid and nucleic acid in the epicuticle of *Echinorhynchus gadi*.

In this report, We report upon the identification of adult worms that were found in ‘changran-pickles’ and ‘myungran-pickles’ by the Institute of Health & Environment, Seoul Metropolitan Government, which were respectively made from *Gadus macrocephalus* and *Theragra chalcogramma* caught in the Korea, by morphological observation and the measurement of internal organs.

**Materials and Methods**

*Echinorhynchus gadi* were gathered from ‘changran-pickles’ and ‘myungran-pickles’ by the Institute of Health & Environment, Seoul Metropolitan Government, and which were made from *Gadus macrocephalus* and *Theragra chalcogramma*. The infected fishes were caught in the Korea. Dead worms from ‘the pickles’ were fixed in



**Fig. 4.** Structure of male worm (a) anterior, (b) testis, (c) cement glands.

**Table 1.** Measurement of male worms

		male worms	
		No. 1	No. 2
Body	L*(mm)	22	15
	W**	0.8-0.6	0.6-0.4
Proboscis	L(μ)	284.8	524.9
	W	227.6	151.4
Proboscis sheath	L(μ)	1570.7	751.9
	W	72.7	280.4
Lemnisci	L(μ)	2566.7	1085.6
	W	-	-
Testis	L(μ)	2202.9-1860.5	1033-981.1
	W	737.0-575.7	463.1-351.6
Cement gland	L(μ)	940.2	610.0
	W	441.2	369.1

\*L: length  
\*\*W: width

70% ethanol. Osmotic pressure and pH were not controlled during fixation. Fixed worms were stained with Mayer's acid carmine and dehydrated through a graded series of 70%, 80%, 95% and 100% ethanol and transferred to xylene. Finally, they were mounted in Canadian balsam.

In order to identify the worms, the length, and width of the body and internal organs were measured. Species identification was made according to Van Cleave [9] and Yamaguti [11] classification of the acanthocephala.

**Results**

**Morphology of male worms**

All worms had a milk-white color, a smooth surface and cylindrical body trunks. On the anterior, they had

cylindrical proboscis with hooks. The hooks on the proboscis were symmetrically arranged in 18-19 longitudinal rows, with 4 hooks per row, which became smaller toward the base of the proboscis. The hook terminals were very sharp and their roots were simple and round. In each worm, there were two lateral claviform protrusions, lemnisci, from the body wall at the base of neck. In the middle of the trunk, two elliptical testes were arranged linearly. Posterior to the testes, six cement glands, pyriform in shape were arranged linearly, with ducts leading into the sperm duct. Table 1 shows the measurements of each male organ of *E gadi*.

**Morphology of female worms**

Female *E gadi* was usually larger than the males. The proboscis and its arrangement, the shapes of the hooks on the proboscis were similar to those of the males, and the hooks on the proboscis were symmetrically arranged in 14-18 longitudinal rows, with 6-10 hooks per row that became smaller toward the base of proboscis. There were also two lateral lemnisci at the base of neck, which were claviform or pyriform in shape. The body cavity of the female worms was filled with eggs with a polar prolongation of the middle shell, and of fusiform shape. The uterine bell and the uterus in the posterior portion of body. Table 2 shows the measurements of each female organ *E gadi*.

**Discussion**

In the classification of acanthocephala by Van Cleave [9] and Yamaguti [11], the body of *Echinorhynchus* was small or middle-sized in the acanthocephala, and proboscis was cylindrical in shape and the hooks on the proboscis were arranged in 9-26 longitudinal rows, with 4-16 hooks per

**Table 2.** Measurement of female worms

		female worms						
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
Body	L*(mm)	14	20	34	47	51	30	45
	W**	0.3-0.7	0.8-0.3	0.9-0.5	2.1-1.3	1.9-0.9	2.2-1.4	0.8-0.7
Proboscis	L(μ)	466.1	-	-	-	331.7	-	252.0
	W	259.9	-	-	-	254.0	-	268.9
Proboscis sheath	L(μ)	506.0	1063.7	1550.7	1120.6	1018.9	1131.5	1313.7
	W	298.8	231.1	275.9	257.9	266.9	295.8	261.0
Lemnisci	L(μ)	639.4	930.3	1177.3	1454.2	1267.9	1325.7	473.1
	W	-	-	-	-	-	-	-
Egg	L(μ)	51.7	112.4	68.6	81.7	87.3	98.1	-
	W	14.0	28.5	16.1	17.5	16.5	28.8	-
Uteriner bell and Uterus	L(μ)	1358.5	1124.5	1229.1	-	-	-	34.9
	W	69.0	49.8	84.7	-	-	-	654.4

\*L: length  
\*\*W: width

row and became smaller towards the base of the proboscis. Male worms had two testis arranged linearly in the middle or posterior portion of the body with six cement glands arranged linearly in the posterior portion of body. Van Cleave [9] noted that worms of *Echinorhynchus* among the genera possess a proboscis with fully developed hooks in the cystacanth stage.

In these specimens, the hyperdermic nuclei and lacunar system, which were described in the reports of Van Cleave [9] and Yamaguti [11] could not be observed and cystacanth neither could. However, the morphological characteristic features of each organ of the specimens corresponded to those listed by Van Cleave [9], Yamaguti [11] and David [4]. The size, arrangement, number and morphological character of the body, eggs, and hooks also correspond to those listed by Arai [1] and Petrochenko [7].

According to the above morphological features, those acanthocephala, which were collected from 'changgran-pickles' and 'myungran-pickles' were identified as *Echinorhynchus gadi*.

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