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Descriptions of Four New Species of Actinolaimoidea (Dorylaimida: Nematoda) from Korea

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한국산 Actinolaimoidea上科의 (Dorylaimida: Nematoda) 4신종 기재

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ABSTRACT

Four new species of predatory nematodes belonging to the Actinolaimoidea, Dorylaimida are described. *Neoactinolaimus gosungensis* n. sp. is 2.2-2.4 mm long, b = 4.3-4.9; c = 10.7-11.2; spicules 60-62 μm long and is distinguishable by low lip region, asymmetrical odontostyle and its wider lumen. *Egtitus arcuatus* n. sp. is 1.5-1.8 μm long, b = 3.6-4.2; c=14-15 and is characterized by having dorsally arcuate odontostyle and presence of cardiac glands at base of oesophagus. *Paractinolaimus tuberculatus* n. sp. is 1.9-2.5 mm long, b = 3.3-4.0, c = 7.2-8.8, spicules 66-69 μm long and is unique in having coiled body posture and a tubercle at the base of oesophagus. *Carcharolaimus koriensis* n. sp. is 1.7-1.9 μm long, b = 3.6-4.5, c = 65-76 and is characterized by having very thick body cuticle and larger odontostyle aperture.

Key words: Taxonomy, *Carcharolaimus, Egtitus, Neoactinolaimus, Paractinolaimus*

INTRODUCTION

During the study of Dorylaimida from Korea, the soil samples were collected from the various localities which yielded four new species. They are as follows: *Neoactinolaimus gosungensis* n. sp., *Egtitus arcuatus* n. sp., *Paractinolaimus tuberculatus* n. sp. and *Carcharolaimus koriensis* n. sp.. Two of these genera, *viz.*, *Neoactinolaimus* and *Carcharolaimus* are being reported here for the first time from Korea.

MATERIALS AND METHODS

The nematodes were extracted from soil samples by Cobb's sieving methods and centrifugal sugar-flotation technique. Nematodes obtained in clear water were killed and fixed in hot (70°C) F : G 4-1 fixative. These nematodes were dehydrated by Seinhorst's rapid glycerine method. Measurements and drawings were made with a drawing tube attachment with Olympus BX 50 microscope.

DESCRIPTIONS

Neoactinolaimus gosungensis n. sp.
(Figs 1, 2)

Measurements:

Holotype (Female): L = 2.3 mm; a = 50; b = 4.6; c = 10.7; c′ = 8.7; V = 42; G_1 = 12.5; G_2 = 12.6; odontostyle = 26 μm; odontophore = 19 μm; oesophagus = 504 μm; prerectum = 218 μm; rectum = 40 μm; tail = 218 μm.

Paratype (Females n = 3): L = 2.4 mm ± 0.05 (2.3-2.4); a = 51 ± 2.6 (49-54); b = 4.7 ± 0.2 (4.6-4.9); c = 11.2 ± 0.7 (10.7-12.0); c′ = 8.5 ± 0.4 (8.1-8.8); V = 41.4 ± 1.3 (40-42.3); G_1 = 13.7 + 1.2 (12.5-14.8); G_2 = 14.8 ± 2.1 (12.6-16.7); odontostyle = 24.7 μm ± 1.2 (24-26); odontophore = 23.3 μm ± 3.8 (19-26); oesophagus = 503 μm ± 9 (493-511); prerectum = 175 μm ± 37

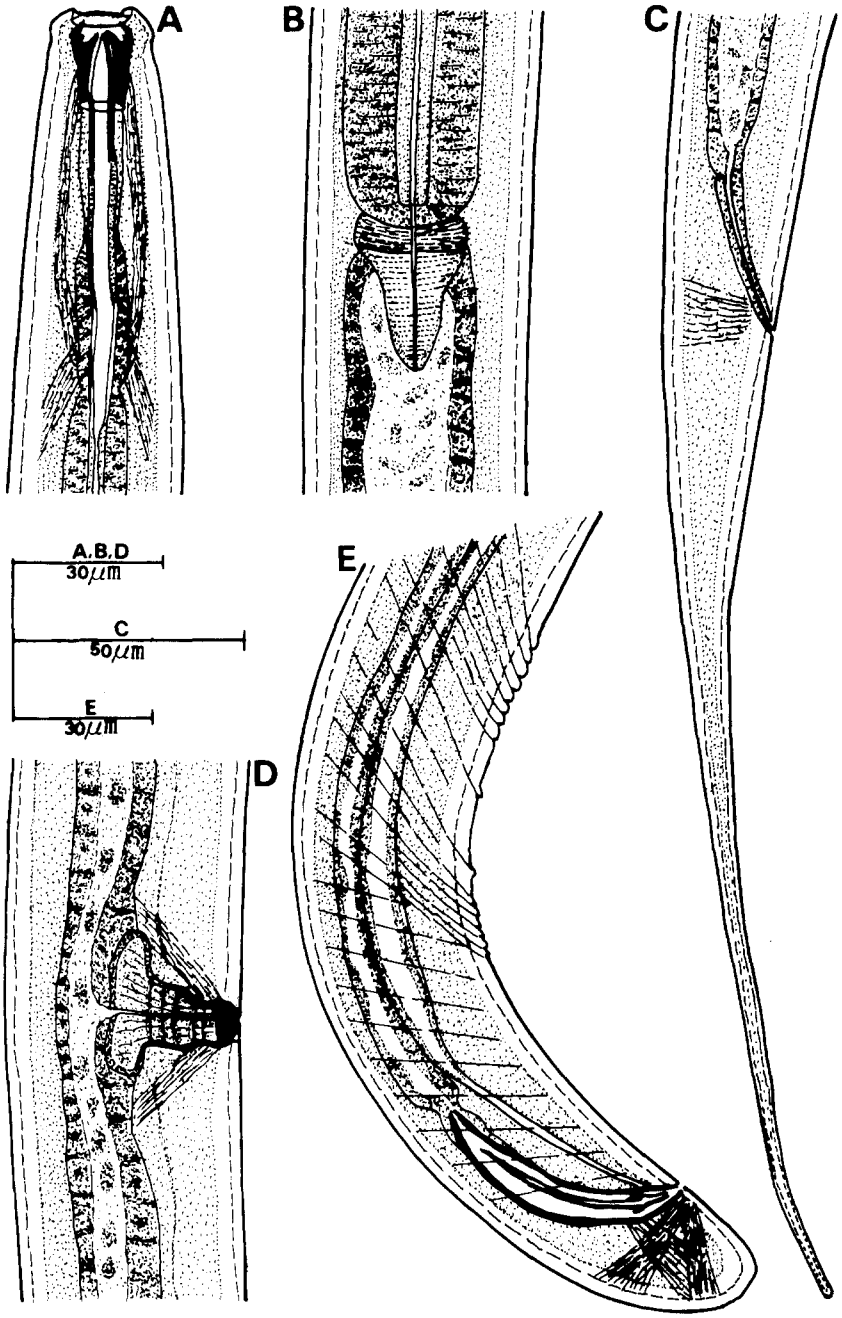

Fig. 1. *Neoactinolaimus gosungensis* n. sp.: A: Anterior region; B: Oesophago-intestinal junction; C: Female posterior region; D: Vulval region; E: Male posterior region.

(150-218); rectum = 41 μm ± 7 (34-48); ABD = 25 μm ± 1 (24-26); tail = 214 μm ± 9.3 (203-220).

Paratype (Males n = 3): L = 2.3 μm ± 0.1 (2.2-2.4); a = 49 ± 1 (48-50); b = 4.4 ± 0.1 (4.3-4.5); c = 86 ± 5.6 (81-86); c′ = 0.9 ± 0.1 (0.8-1.0); odontostyle = 24 μm ± 1.0 (23-25); odontophore = 24 μm ± 3.6 (20-27); oesophagus = 523 μm ± 5.6 (518-529); prerectum = 319 μm ± 26.6 (290-342); rectum = 42 μm ± 5 (37-47); spicules = 61 μm ± 1.0 (60-62); lateral guiding pieces = 12 μm ± 1 (11-13); ABD = 32.3 μm ± 3.1 (29-35); tail = 27.3 μm ± 2.2 (25-29).

Female: Body ventrally curved when fixed, more so in the posterior region, especially in males. Cuticle smooth about 3 μm thick. Lateral body chords one-fourth to one-fifth of corresponding body width wide at base of oesophagus. Lip region narrow, rounded, off set by slight depression, 18-20 μm wide and 6-7 μm high or three times wider than high.

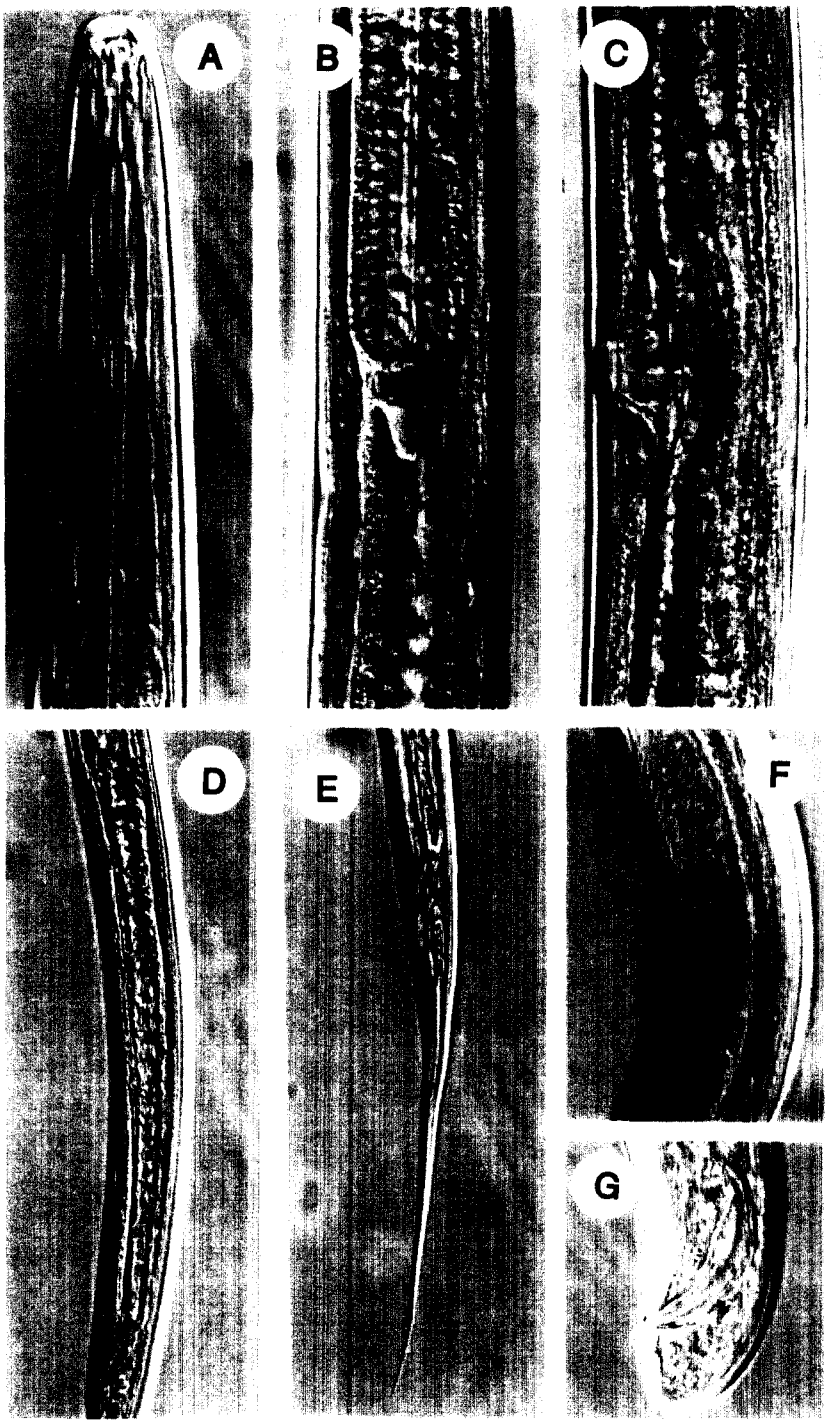

Fig. 2. *Neoactinolaimus gosungensis* n. sp.: A: Anterior region; B: Oesophago-intestinal junction; C: Vulval region; D: Female prerectum; E: Female tail; F: Male posterior region showing fascicles; G: Male tail showing copulatory apparatus.

Amphids stirrup-shaped, with aperture about half of lip region width wide. Vestibular ring corrugated. Pharynx armed with four large onchia, each onchium provided with a secondary tooth. Odontostyle 1.2-1.4 times lip region width long, with 3-4μm wide lumen, aperture about two-fifths of its length. Odontostyle arms asymmetrical, dorsal arm posteriorly longer than ventral one. Odontophore simple rod-like, almost equal to odontostyle length with 3-4 μm wide lume. Guiding ring 'double', fixed ring at 19-20 μm from anterior end of body. Post-extesion constriction of oesophagus present, located at

72-79 μm from anterior end and 44-47 μm from base of odontostyle. Oesophagus dorylaimoid, 504-529 μm long, anterior slender portion expands gradually. Basal expanded portion of oesophagus occupying 46-52% of total oesophageal length. Basal shield of oesophagus present. Cardia elongate conoid, 34-39 μm long, inserted deep into intestine.

Reproductive system didelphic, amphidelphic. Vulva a transverse slit. Vagina muscular, about two-fifths of corresponding body widths deep, distally provided with cuticularized pieces. Both sexual branches equally developed. Ovaries reflexed, oocytes arranged in a single row except near tip. Sphincter present between uterus and oviduct. Prerectum large, 6-7 times of anal body widths long. Rectum 1.4-1.9 anal body width long. Tail 8-9 anal body width long, uniformly tapering to become long filiform.

Male: Testes paired, opposed, dorylaimoid. Spicules arcuate, 1.8-2.1 times anal body widths long. Lateral guiding pieces 11-13 μm long. Supplements an adanal pair and ventromedians arranged in two groups (fascicles) each with 7-8 innervations. One solitary supplement present between two fascicles. Prerectum about 10 times anal body width long, terminating well beyond the supplements. Rectum 1.1-1.7 anal body widths long. Tail bluntly rounded less than anal body width long.

Diagnosis and relationships: The new species is distinguishable by its lower lip region, asymmetrical odontostyle, wider lumen of odontostyle and odontophore. New species come close to *Neoactinolaimus kosambus* Khan *et al.*, 1994 but differs from that in having more slender body, anteriorly located vulva, longer tail and spicules (a = 31-39, V = 48-55, tail = 163-190 μm and spicule = 48-51 μm in *N. kosambus*).

Type material: Holotype female, paratype females and males of *Neoactinolaimus gosungensis* n. sp. on slides deposited in the nematode collection of Department of Agricultural Biology, College of Agriculture, Kyungpook National University, Taegu, Korea.

Type habitat and locality: Soil samples collected from around rhizosphere of pine tree (*Pinus densiflora* S. et Z.) from Kosŏng, Kangwon province, Korea. Collected in July, 1987.

Egtituts arcuatus n. sp.
(Figs. 3, 4)

Measurements:

Holotype (Female): L = 1.5 mm; a = 45; b = 4.2; c = 14; c′ = 5.4; V = 54; odontostyle = 22 μm; odontophore = 22 μm; oesophagus = 421 μm; prerectum = 58 μm; rectum = 28 μm; ABD = 20 μm; tail = 107 μm.

Paratype (Females n = 3): L = 1.7 mm ± 0.12 (1.5-1.8); a = 44.4 ± 1.7 (43-47); b = 4 ± 0.2 (3.6-4.2); c = 15 ± 0.8 (14-16); c′ = 5.1 ± 0.4 (4.7-5.5); V = 53 ± 0.9 (52-54); G_1 = 14.4 ± 1.9 (13-15.7); G_2 = 12 ± 1 (11-13); odontostyle = 21.6 μm ± 1.1 (20-23); odontophore = 20.8 μm ± 1.1 (20-22); oesophagus = 420 μm ± 6 (414-428); prerectum = 66 μm ± 16.7 (50-94); rectum = 31.5 μm ± 3.9 (28-37); ABD = 22 μm ± 2.3 (20-25); tail = 112 μm ± 7.5 (104-123).

Female: Body slightly ventrally curved upon fixation. Cuticle finely transversely striated, 2-3 μm thick at mid-body and 4-5μm at tail. Lateral body chords occupying about one-fourths of corresponding body-width wide at base of oesophagus. Lip region rounded, off set by slight expansion, 16-17 μm wide and 7-8 μm high or about twice as wide as high. Amphids stirrup-shaped, with aperture about two-fifths of corresponding body width wide. Vestibular ring corrugated. Pharynx armed with four large onchia. Odontostyle dorsally curved, 1.2-1.4 times of lip region width long with aperture about half of its length. Guiding ring 'double', fixed ring at 13-14 μm from anterior end. Odontophore simple rod-like, almost equal to odontostyle length. Post-extesion constriction of oesophagus present, located at 63-65 μm from anterior end and 37-40 μm from base of odontostyle. Nerve ring located at 125-152 μm from anterior end. Basal expanded part of oesophagus occupies about half of total oesophageal length. Basal shield of oesophagus present. Three conspicous gland-like structures present at the base of oesophagus. Cardia elongate-conoid, 15-20 μm long. Reproductive system didelphic, amphidelphic. Vulva transverse, flushed with body. Vagina thick, about two-fifths of corresponding body width deep, provided with 5-6 muscle bands. Both sexual branches equally developed. Ovaries reflexed with oocytes arranged in a single row except near tip. Sphincter present between uterus and oviduct. Prerectum 2.0-3.9 times anal body widths long. Rectum 1.2-1.5 anal body widths long. Tail 4.7-5.5 anal body widths long, gradually tapering to elongate with pointed terminus.

Male: Not found.

Diagnosis and relationships: The new species is distinctive in having dorsally curved odontostyle with wide lumen and aperture, and presence of gland-like structures at base of oesophagus. New species resembles to *Egtitus koriensis* Khan *et al.* 1999 but differs from it in the shape of lip region, odontostyle, vulva, and in having smaller rectum (lip region expanded, odontostyle straight, vulva elevated from body con-

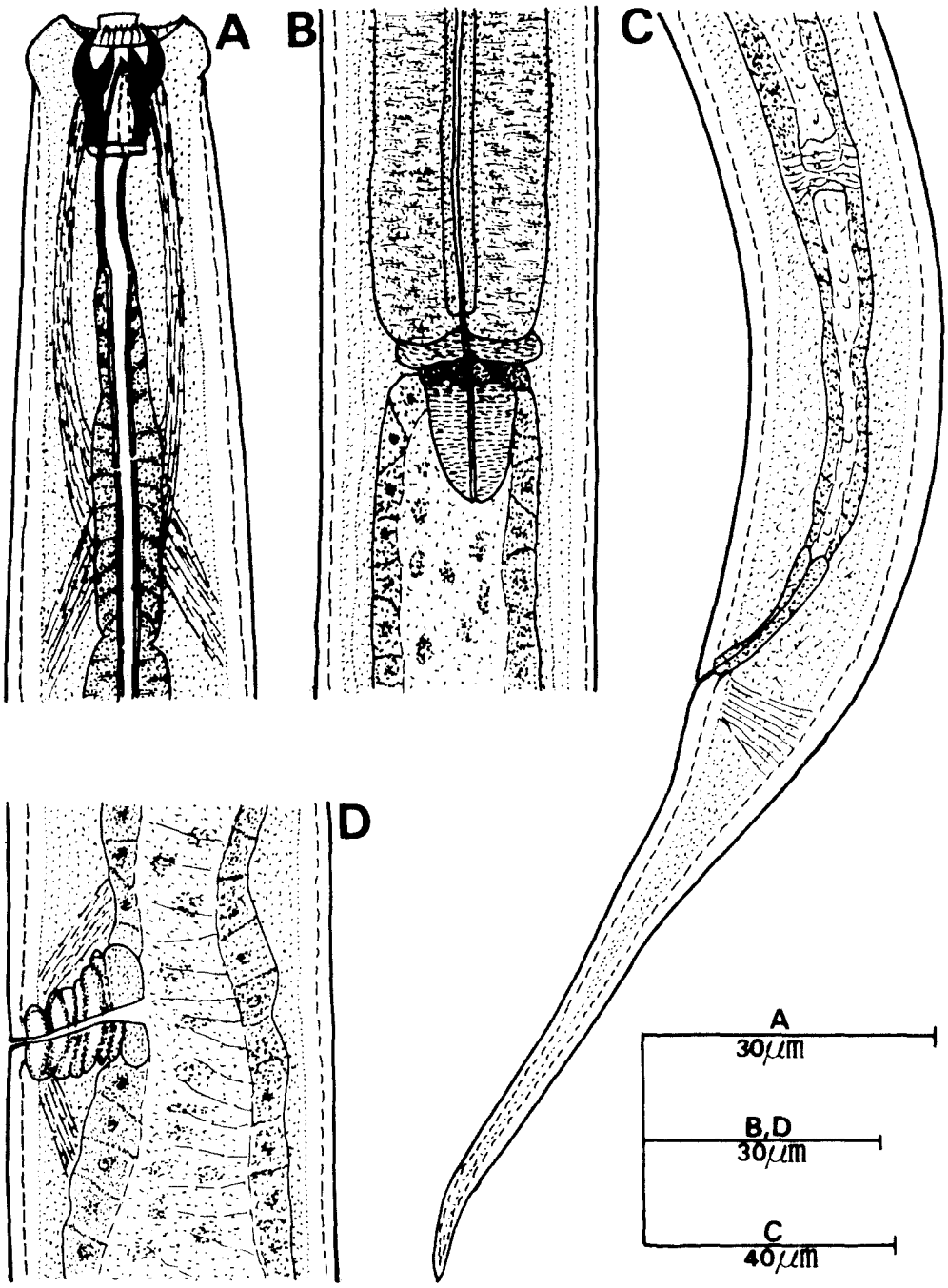

Fig. 3. *Egtitus arcuatus* n. sp.: A: Anterior region; B: Oesophago-intestinal junction; C: Female posterior region; D: Vulval region.

tour and rectum 44-46 μm long in *E. koriensis*). The new species also come close to *E. naunii* Khan & Jairajpuri, 1994 but differs from that in the shape of lip region, odontostyle and in the presence of gland-like structures at the base of oesophagus (lip region wide, odontostyle straight and no glandular structure at the base of oesophagus in *E. naunii*).

Type material: Holotype and paratype females of *Egtitus arcuatus* n. sp. on slides deposited in the nematode collection of Department of Agricultural Biology, College of Agriculture, Kyungpook National University, Taegu, Korea.

Type habitat and locality: Soil samples collected from around rhizosphere of pine tree (*Pinus densiflora* S. et Z.) from Taegu city, Korea. Collected in July, 1992.

Paractinolaimus tuberculatus n. sp.
(Figs. 5, 6)

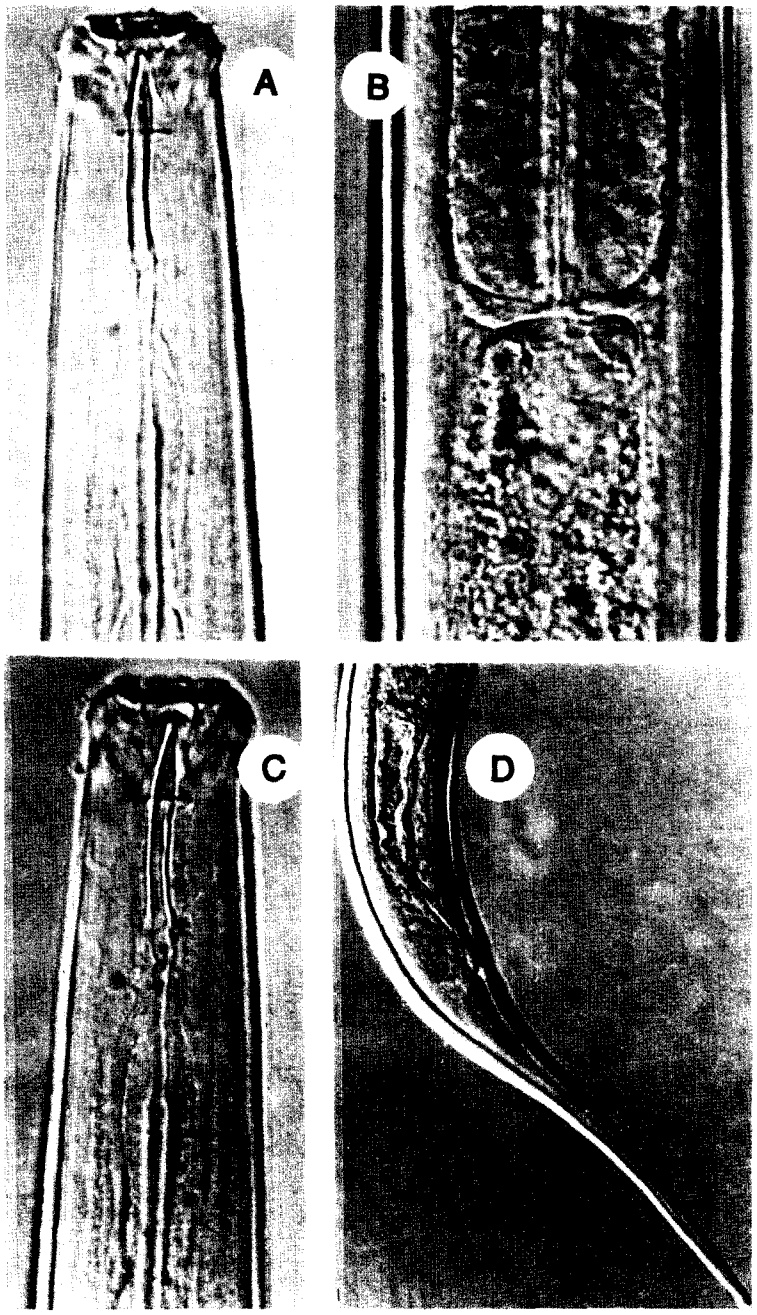

Fig. 4. *Egtitus arcuatus* n. sp.: A: Anterior region; B: Oesophago-intestinal junction; C: Anterior region showing odontostyle curvature; D: Female posterior region.

Measurements:

Holotype (Female): L = 2.4 mm; a = 42; b = 3.8; c = 8.8; c′ = 8.8; V = 46; G_1 = 14.6; G_2 = 16.3; odontostyle = 26 μm; odontophore = 27 μm; oesophagus = 641 μm; prerectum = 176 μm; rectum = 52 μm; ABD = 31 μm; tail = 274 μm.

Paratype (Females n = 5): L = 2.4 mm ± 0.1 (2.3-2.5); a = 41.2 ± 1.9 (39-44); b = 3.9 ± 0.1 (3.8-4.0); c = 7.7 ± 0.6 (7.2-8.8); c′ = 9.7 ± 0.6 (8.8-10.2); V = 46.5 ± 1.0 (46-47); G_1 = 12.6 ± 1.7 (11-14.6); G_2 = 14.2 ± 2.2 (12-16.8); odontostyle = 25.8 μm ± 1.5 (24-28); odontophore = 24.8 μm ± 1.6 (23-27); oesophagus = 608 μm ± 26 (576-641); prerectum = 121 μm ± 33 (92-176); rectum = 51 μm ± 2.2 (48-53); ABD = 32 μm ± 1.1 (31-34); tail = 311 μm ± 27 (274-346).

Paratype (Males n = 5): L = 2.1 mm ± 0.12 (1.9-2.2); a = 37.4 ± 2.1 (34-39); b = 3.6 ± 0.2 (3.3-3.8); c = 73.4 ± 4.6 (68-78); c′ = 73 ± 5.9 (67-81); odontostyle = 25.4 μm ± 1.4 (24-27);

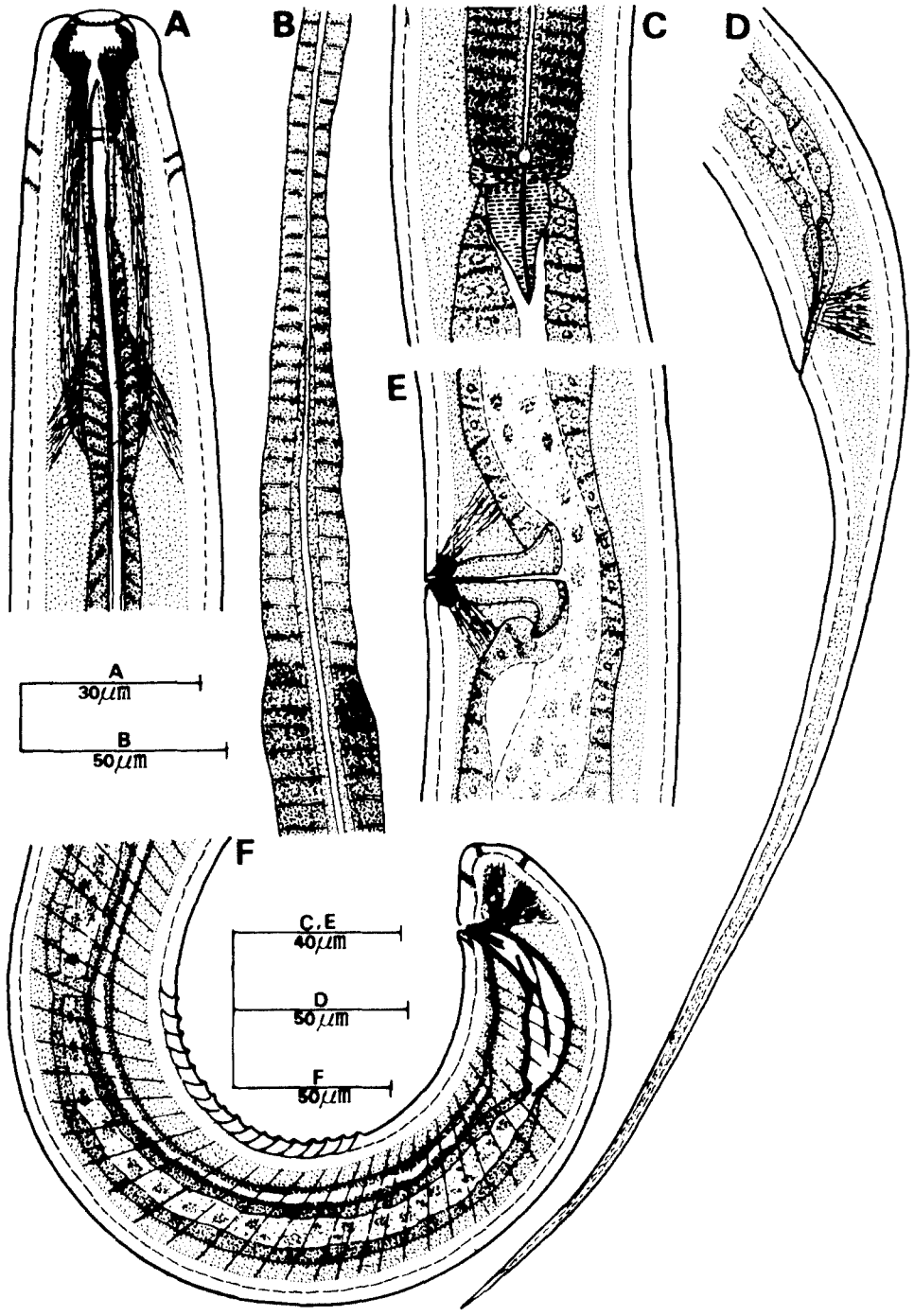

Fig. 5. *Paractinolaimus tuberculatus* n. sp.: A: Anterior region; B: Anterior portion of oesophagus; C: Oesophago-intestinal junction; D: Female posterior region; E: Vulval region; F: Male posterior region.

odontophore = 25.8 μm ± 1.3 (24-27); oesophagus = 567 μm ± 18.6 (536-580); spicules = 69 μm ± 2.2 (66-69); prerectum = 163 μm ± 39 (117-215); rectum = 57.2 μm ± 4.8 (52-64); ABD = 38 μm ± 1.0 (37-39); tail = 28 μm ± 1.4 (26-30); lateral guiding pieces = 14-16 μm; ventromedian supplements = 15-19.

Female: Body coiled when fixed. Cuticle with fine transverse striations, 3-4 μm thick at mid-body and 4-5 μm on tail. Lateral chords about one-fifths of corresponding body width wide at base of oesophagus. Lip region almost continuous or marked off by slight depression, rounded. Amphids stirrup-shaped, aperture about half of lip region width wide. Vestibule corrugated. Pharynx armed with four large onchia,

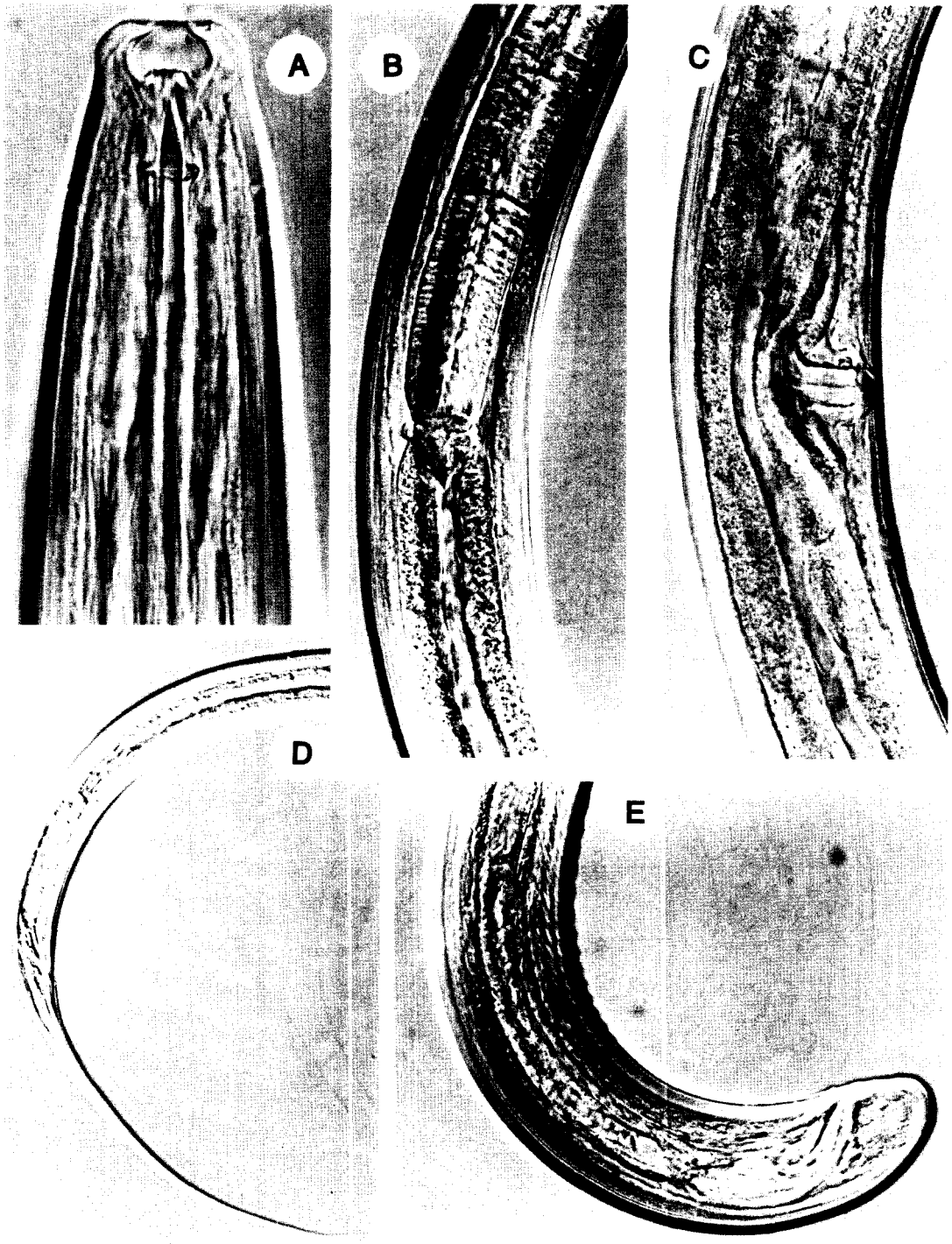

Fig. 6. *Paractinolaimus tuberculatus* n. sp.: A: Anterior region; B: Oesophago-intestinal junction; C: Vulval region; D: Female posterior region; E: Male posterior region.

slightly ribbed and numerous denticles. Odontostyle 1.2-1.3 times lip region width long with aperture about half of its length. Guiding ring 'double', fixed ring located at 20-23 μm from anterior end. Odontophore rod-like, almost equal to odontostyle length. Nerve ring located at 164-201 μm from anterior end. Oesophagus at first a slender tube with radial muscles, enlarged by gradual expansion to join the massive basal expanded portion which occupies 47-53% of total oesophageal length. This enlarged portion has strong radial muscles and conspicuously glandular tissues. At the base of

oesophagus its lumen widen to form a small cuticularized tubercle-like structure. Basal shield of oesophagus present. Cardia elongate conoid, 24-33 μm long, inserting deep into the intestine. Reproductive system didelphic, amphidelphic. Both sexual branches equally developed. Vulva a transverse slit. Vagina muscular, about half of corresponding body width deep, provided with distinct cuticularized pieces. Ovaries well developed with oocytes arranged in a single row except near tip. Sphincter present at oviduct-uterus junction. Prerectum 3-5 anal body widths long. Rectum 1.5-1.7 anal body width long. Tail gradually tapering to long filiform, 9-10 anal body widths long.

Male: Testes paired, opposed, dorylaimoid. Spicules dorylaimoid, 1.7-1.9 anal body widths long. Lateral guiding pieces about one-fifths of spicular length. Supplements, an adanal pair and 15-19 regularly spaced ventromedians arranged in series. Prerectum 3.2-5.6 anal body widths long, terminating at the level of anterior most supplement. Rectum 1.4-1.6 anal body widths long. Tail bluntly rounded, less than anal body width long with three caudal pores on each side.

Diagnosis and relationships: The new species is characterized by having coiled body posture, continuous lip region,

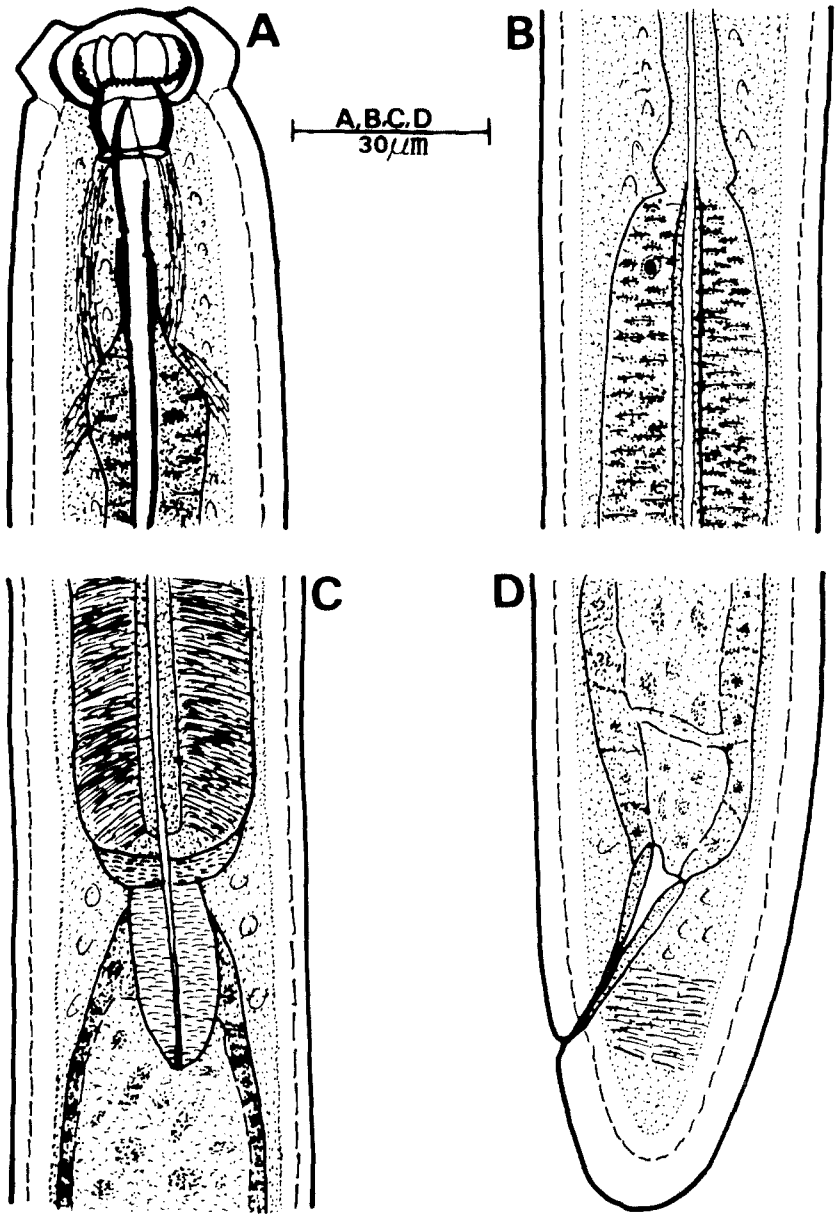

Fig. 7. *Carcharolaimus koriensis* n. sp.: A: Anterior region; B: Oesophagus showing junction of anterior slender and posterior expanded part; C: Oesophago-intestinal junction; D: Female posterior region.

slightly ribbed pharyngeal chamber, very gradual oesophageal expansion, a tubercle at base of oesophagus and long filiform female tail. The new species comes close to Paractinolaimus acutus Khan and Park, 1999 in the shape and size of lip region, odontostyle and odontophore. But it differs from that in having smaller 'c' value, presence of tubercle at base of oesophagus, absence of vulval papillae and in the presence of males (c = 10-12, no tubercle at base of oesophagus, one pre- and two post-vulval papillae present and male absent in *P. acutus*).

Type material: Holotype female, paratype females and males of *Paractinolaimus tuberculatus* n. sp. on slides de-

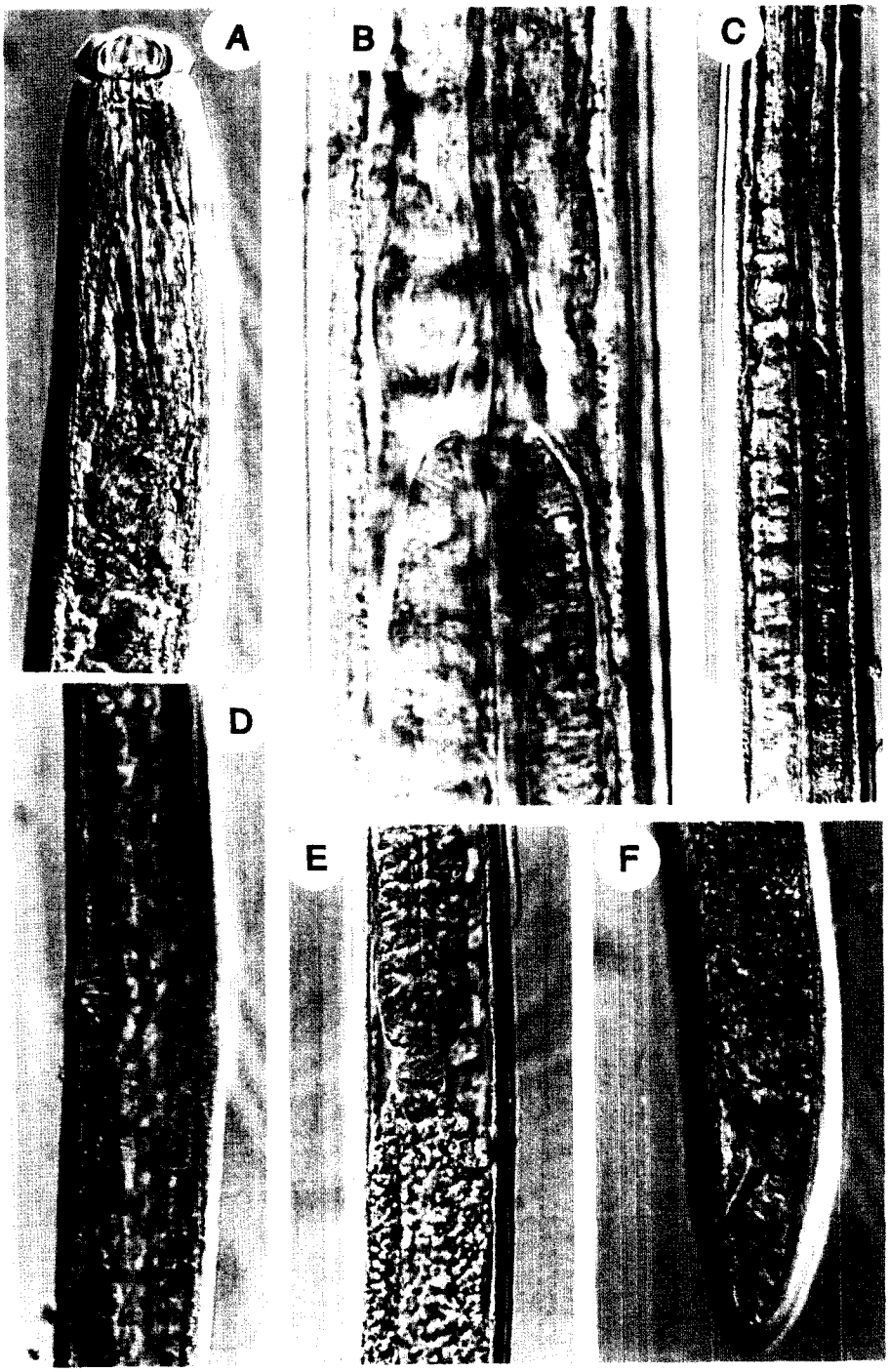

Fig. 8. *Carcharolaimus koriensis* n. sp.: A: Anterior region; B & C: Oesophagus showing junction of anterior slender and posterior expanded part; D: Vulval region; E: Oesophago-intestinal junction; F: Female posterior region.

posited in the nematode collection of Department of Agricultural Biology, College of Agriculture, Kyungpook National University, Taegu, Korea.

Type habitat and locality: Soil samples collected from around rhizosphere of peanut (*Arachis hypogaea* L.) from Taegu city, Korea. Collected in April, 1983.

Carcharolaimus koriensis n. sp.
(Figs. 7, 8)

Measurements:

Holotype (Female): L = 1.9 mm; a = 35; b = 4.5; c = 76; c′ = 0.7; V = 47; odontostyle = 23 μm; odontophore = 16 μm; oesophagus = 425 μm; prerectum = 60 μm; rectum = 32 μm; ABD = 34 μm; tail = 25 μm.

Paratype (Females n = 2): L = 1.7-1.8 mm; a = 29-36; b = 3.6-4.1; c = 65-73; c′ = 0.7-0.8; V = 47-50; odontostyle = 20-24 μm; odontophore = 17-18 μm; oesophagus = 443-461 μm; prerectum = 55-65 μm; rectum = 31-33 μm; ABD = 31-35 μm; tail = 23-28 μm.

Juvenile (n = 1): L = 1.9 mm; a = 44; b = 4.6; c = 74; c′ = 0.8; odontostyle = 20 μm; odontophore = 18 μm; oesophagus = 418 μm; rectum = 38 μm; ABD = 31 μm; tail = 26 μm.

Female: Body plump, straight or slightly curved ventrally; slightly tapering towards extremities. Cuticle marked by minute transverse striations, 4-5 μm thick at mid-body and 7-8 μm on tail terminus. Lateral body chords about one-fourth of corresponding body width wide at mid body and provided with conspicuous glandular organs. Lip region set off by deep constriction, 28-32 μm wide and 11-12 μm high. Lips very prominent and large angular, labial papillae visible. Amphids shallow, cup-shaped, their aperture 7-9 μm wide, located at 11-12 μm from anterior end. Pharynx hexagonal with 12 strong refractive ribs forming a basket-like chamber. Numerous jagged teeth about base of pharynx and many minute denticles present on walls. Four strongly sclerotized pillars extend back to guiding ring. Odontostyle thick, stout, 20-24 μm long, cylendrical, aperture 12-14 μm or more than half of its length. Guiding ring 'double', fixed ring located at 20-22 μm from anterior end of body. odontophore simple, rod-like, 16-18 μm long. Post-extension constriction of oesophagus absent. Oesophagus at first a slender non-muscular tube, suddenly expands in posterior two-thirds. Basal expanded part of oesophagus very muscular obscuring locations of all glands except dorsal one. Basal shield of oesophagus present. Cardia elongate-conoid, 19-29 μm long, anterior disc-like portion not surrounded by intestinal cells. Intestine cells packed with dark granules. Reproductive system amphidelphic, both sexual branches equally developed. Vulva a longitudinal slit, vagina extending one-fourth to one-fifths of corresponding body width deep. Ovaries reflexed, oocytes arranged in a single row except near tip. Demarcation of different parts of gonad not very clear due to dense granulations. Prerectum more than anal body width long. Rectum equal to or less than anal body width long. Tail short, conoid to rounded with thick cuticle at terminus

Male: Not known.

Diagnosis and relationships: The new species is characterized by having very thick cuticle, especially on tail terminus and larger odontostyle aperture. It comes close to *C. ramirazi* Thorne, 1967 and *C. dentatus* Thorne, 1939. But differs from former in the shape of odontostyle and in absence of ventral body pores (odontostyle concave in dorsal side with aperture less than half of its length in *C. ramirazi*). From later it differs in the absence of cardiac glands, presence of cardiac disc and larger tail (cardiac glands present, cardiac disc absent and c = 81 in *C. dentatus*).

Type material: Holotype female, paratype females and juvenile of *Carcharolaimus koriensis* n. sp. on slides deposited in the nematode collection of Department of Agricultural Biology, College of Agriculture, Kyungpook National University, Taegu, Korea.

Type habitat and locality: Soil samples collected from around rhizosphere of peanut (*Arachis hypogaea* L.) from Taegu city, Korea. Collected in April, 1983.

Acknowledgement: One of the authors, Zakaullah Khan is highly thankful to the Kyungpook National University, Taegu for providing Post-Doctoral Fellowship to carry out the present research work at the Institute of Agricultural Sciences and Technology.

적 요

Actinolaimoidea 상과에 속하는 4신종을 기재 하였다. *Neoactinolaimus gosungensis* n. sp.는 체장이 2.2-2.4 mm 이고, b = 4.3-4.9; c = 10.7-11.2; 交接刺는 60-62 μm이다. 口脣部는 낮고, 비대칭형인 槍針과 넓은 管腔을가진다. *Egtitus arcuatus* n. sp.는 체장이 1.5-1.8 mm이고, b = 3.6-4.2; c = 14-15, 槍針은 背部로 굽었고, 식도의 기부에 食道腸間弁이 있다. *Paracttinolaimus tuberculatus* n. sp.는 체장이 1.9-2.5 mm이고, b = 3.3-4.0, c = 7.2-8.8, 交接刺는 66-69 μm이고 특이하게 몸통이 꼬였고, 식도의 기부에 結節이 있다. *Carcharolaimus koriensis* n. sp.는 체장이 1.7-1.9 mm이고, b = 3.6-4.5, c = 65-76 그리고 표피가 매우 뚜껍고 槍針孔이 큰

것이 특징이다.

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