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A NEW NEMATODE *CAMALLANUS BOOMKERI* SP. FROM THE FISH, *CHANNA ORIENTALIS* (OESTIECHTHYES: CHANNIDAES) IN FRESHWATERS OF PANJGUR, BALOCHISTAN

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ABSTRACT

The present study was conducted to investigate the helminth parasites of fish. During this study a new species of genus *Camallanus* Railliet and Henry, 1915 (Nematoda: Camallanidae) is described from specimens found in the swim bladder of *Channa orientalis* Bloch and Schneider, 1801 collected from River Gwarko in Panjgur (Balochistan). This new species *Camallanus boomkeri* n. sp. differs from other reported forms of the genus on the basis of number of longitudinal ridges, body measurements and the caudal end of both sexes. It may also be differed in tridents nature, length of spicules and anal papillae number in males, and by the inflation of vulva lips in females and excretory pore position.

Key words: Nematode, *Camallanus boomkeri* n. sp., freshwater fish, *Channa orientalis*.

INTRODUCTION

The genus *Camallanus* was established by Railliet and Henry (1915) to include *C. lacustris* (Zoega, 1776). Species of the genus are widely distributed over the world. It has been studied that many species of this group of nematode are described from stomach or intestine of frog, turtle and most frequently from numerous fish species (Gupta, 1959; Yamaguti, 1961; Agrawal, 1967; Sood, 1989; Kuzmin *et al*., 2009). To date, there are generally few data is available on morphology and systemic evaluation of *Camallanus* sp. in Pakistan. Previously only four species of the genus have been reported from freshwater fishes namely, *C. xenentodoni* (Khan and Yaseen, 1969) (based on only females) *in Xenentodoni cancilla*; *C. vachaii* (Wahid and Perveen, 1969) in *Eutropiichthyes vacha*; *C. barragi* (Zaidi and Khan, 1975) (based on only males) in *Mastacembalus armatus*; *C. charsaddiensis (*Siddiqi and Khattak 1984) in *Channa gachua*. However, Ashraf *et al*. (1977) reported the presence of *Camallanus* species in marine fishes of Pakistan.

The present study describes a new species of camallanid nematode found in the swim bladder during a parasitological fauna survey of perciform fish, *Channa orientalis* (Bloch and Schneider, 1801) from River Gwarko, Panjgur. This is the first report of helminth parasite from swim bladder of *C. orientalis* and also new locality record. The specimens under study do not agree with descriptions of known species of the genus *Camallanus* (Railliet and Henry, 1915). Hence a new species *Camallanus boomkeri* n. sp. has been erected to accommodate the present specimens.

MATERIALS AND METHODS

Fishing and sampling site: In March 2008, fourteen *C. orientalis* (Pisces: Oestichthyes) were caught by baited traps in River Gwarko, Panjgur (26°-14 to 27°-18 N latitudes: 63°-07 to 65°-24E longitudes), southwest Balochistan. Fish were fixed in 10 % formaldehyde, measured (body length 9-14 cm) and also examined to find out if there were any nematodes.

Microscopy and mounting: The recovered nematodes were preserved in 70% ethanol and then cleared in phenol-glycerin (1:3) for light microscopic (CH-4 Olympus Optical Co. Ltd. Japan) examination. Four males and 5 females were studied. These were mounted temporary in pure glycerin.

Illustrations and Measurements: Drawings were made with the help of Zeiss microscope drawing attachment (Leitz Wetlar Germany / 1.75 X). Measurements are taken from a compound microscope with the use of stage-micrometer and an ocular micrometer. All measurements are taken (length x width) in millimeters. Photographs of parasite specimens were taken by Camera-mounted Microscope (Leica Microsystems Wetzlar GmbH (MPS30-T630mA) made by Leica 86 (LGA), Germany).

Deposition of specimens: Parasite specimens (Holotype, allotype and paratypes) are deposited in the Helminthes Collection in the Museum of Zoology Department, University of Balochistan in Quetta, Pakistan. These are accessible to other researchers on request.

RESULTS AND DISCUSSION

***Camallanus boomkeri* n. sp. (Figures 1-4)**

Type host: *Channa orientalis* Bloch and Schneider, 1801 (Channidae)
Site of infection: Swim bladder
Type locality: River Gwarko, Panjgur, southwest Balochistan
Number of specimens: Nine nematodes including 4 males and 5 females from 5 fish, 14 Hosts were examined
Prevalence and intensity: 5/14 (35.7%), 2-5 specimens per fish, mean (4)
Holotype male: Voucher No. ZBU-N68
Allotype female: Voucher No. ZBU-N69

Description (based on 4 male and 5 female specimens): Slender worms: with blunt anterior and tapering posterior extremities. Body cuticle smooth. Males bear lateral alae found on regions of esophagus and near caudal end. Mouth opening narrow, slit-shaped, with three chitinous projections anteriorly obvious in male worms. Cephalic papillae and lateral amphids not observed. Buccal capsule has identical lateral valves; each valve internally armed by 9 longitudinal ridges varied on length for both sexes. Posterior end of buccal cavity surrounded by thick, sclerotized ring (basal ring) supported by 2 prominent tridents having 3 prongs. Central prongs small, hardly visible. Esophagus divided into anterior muscular and posterior glandular portions. Glandular portion almost longer and broader than muscular ones. Intestine straight, wide. Nerve ring encircles the midregion of muscular esophagus in males: but in females, it encircles the anterior region of muscular esophagus. Deirids not prominent. Excretory pore of both sexes preequatorial. Male worms presented two unequal spicules, relatively slender, rounded anteriorly and pointed posteriorly. Large (left) spicule one and half times longer than small (right) spicule. Caudal end with 12 pairs of (sessile) anal papillae, arranged as 7 preanal, 1 adnal and 4 postanal. Females vulva small with slightly elevated lips, postequatoruial. Muscular vagina directed posteriorly from vulva joining the uterus which contain numerous, smooth eggs. Tail small, tapering to bifid, spiny tips in both sexes.

Males (measurements for holotype and 3 paratypes): Body length 2.1 (1.74-1.95), maximum width 0.1 (0.07-0.09), buccal capsule 0.042 (0.032-0.039) x 0.065 (0.061-0.063), basal ring 0.045 (0.04-0.043) x 0.02 (0.016-0.019), tridents 0.029 (0.024-0.027) x 0.015 (0.01-0.013). Esophagus muscular 0.28 (0.23-0.26) x 0.06 (0.05-0.057), glandular 0.33 (0.25-0.29) x 0.068 (0.061-0.065) in size. Length of both parts of esophagus 1: 1.33-2.03. Nerve ring and excretory pore at 0.127 (0.122-0.125) and 0.9 (0.5-0.7) respectively from anterior extremity. Large spicule 0.32 (0.26-0.29) x 0.016 (0.013-0.015), small spicule 0.175 (0.168-0.171) x 0.12 (0.06-0.08). Spicular ratio 1:1.83 (1: 1.43-1:167). Tail 0.13 (0.09-0.11) mm long.

Females (measurements for allotype and 4 paratypes): Body length 2.23 (1.95-2.1), maximum width 0.14 (0.1-0.13), buccal capsule 0.06 (0.03-0.05) x 0.054 (0.05-0.053), basal ring 0.013 (0.008-0.012) x 0.034 (0.03-0.033), tridents 0.027 (0.023-0.025) x 0.11 (0.007-0.01). Esophagus muscular 0.224 (0.19-0.222) x 0.043 (0.037-0.041), glandular 0.28 (0.21-0.25) x 0.065 (0.06-0.063) in size. Length of both parts of esophagus 1: 1.08-1.27. Nerve ring and excretory pore at 0.124 (0.11-0.12) and 1.0 (0.7-0.9) respectively from anterior extremity. Vulva 0.023 (0.018-0.21) x 0.022 (0.007-0.021), anterior vulvar lip 0.012 (0.008-0.011) x 0.003 (0.001-0.002), posterior 0.014 (0.01-0.013) x 0.004 (0.001-0.003)|. Vulva at 1.12 (0.93-1.11) from posterior extremity. Vagina 0.09 (0.04-0.07) x 0.023 (0.018-0.021). Eggs 0.023 (0.012-0.017) x 0.017 (0.01-0.015) in size. Tail 0.11 (0.05-0.09) mm long.

Railliet and Henry (1915) described the genus *Camallanus* to accommodate the nematodes from fishes. Ali (1956) erected a new genus *Neocamallanus* on the basis of absence of tridents. Yeh (1960 a, b) considered presence or absence of tridents as a variable character and therefore, regarded *Neocamallanus* to be synonym of *Camallannus*. The presence of tridents, spicules and longitudinal ridges are the main characteristics of the genus *Camallannus* were suggested by Moravec (1973) and Gupta and Verma (1978). It is evident from the present study that only fourteen species of the genus reported worldwide lacks tridents (Table 1). The new nematode *Camallanus boomkeri* n. sp. strongly different from the fourteen species in the possession of tridents, smaller body size and bifid, spiny, tail ends in both sexes, and by vulva lips slightly elevated. The present nematodes also different from all of them (except *C. xeneontodoni*, *C. intestinalus*, *C. pernandoi*, *C. kulasirii*, *C. salmonae* and *C. gomtii*,) by a lesser number (9) of longitudinal ridges, smaller buccal capsule and basal ring. Also, they distinguish from them due to shorter measures of spicules ratio (except *C. intestinalus*), glandular esophagus, nerve ring position, smaller number of postanal papilla pairs (except *C. satyapali*) and by curved, pointed distal tip of small spicules. The present specimens may be distigueshed from *C. charsaddiensis*, *C. intestinalus*, *C. kumaoni*, *C. atridentus*, *C. cancelai*, *C. satyapali* and *C. lucknowensis* in the presence of two spicules and alae on males body. The description of *C. xeneontodoni*, *C. pernandoi*, *C. pearsi* and *C. salmonae* are known only from females.

Despite the differences with all above mentioned forms, the present specimens closely resemble *C. vachaii* and *C. charsaddiensis* by their males preanal papillae

number and to *C. cancilai*, *C. satyapali* and *C. gomtii* by vulva position, egg shape and the female tail terminates in two spines respectively. Females of *C. kulasirii* are unknown. The present specimens also resemble *C. barragi* (Zaidi and Khan, 1975) (based on males only) to body length, trident frongs and number and shape of longitudinal ridges. They may be distinguished in spicular ratio and other features as given in table 1.

Moreover, the new nematodes also distinct from following species of *Camallanus* include *C. cotti* (Fujita, 1927); *C. unispiculus* (Khera, 1954); *C. mastacembeli* (Agrawal, 1967); *C. fotedari* (Rain and Dhar, 1972) *C. varanasiensis* (Agrawal, 1974); *C. adamsi* (Bashirullah 1974b); *C. ophiocephali* (Shendge and Deshmuk, 1977b) (based on males only); *C. nandai* (Gupta and Verma, 1978b); *C. aurangabdensis* (Soota, 1983) (based on males only); *C. oxygasterae* (Gupta and Bakshi, 1983) in that these had single spicules in males (except *C. adamsi* and *C. fotedari*) and lack same number of longitudinal ridges (except *C. nandai*, *C. mastacembeli* and *C. unispiculus*) found in the new nematodes. They also may be easily distinct from present specimens because of larger body, buccal capsule and tridents: by the caudal morphology and longer tail in both sexes. In contrast, new nematodes resemble *C. cotti*, *C. varanasiensis* and *C. oxygasterae* in preanal papillae number and vulva located in posterior position. Similar position of vulva also found in *C. fotedari*. Also, they strongly resemble *C. unispiculus*, *C. aurangabadensis*, *C. adamsi* and *C. mastacembeli* in vulva position; length of left spicule; number of anal papillae; and the males with caudal alae respectively. Description of *C. ophiocephali* males is unknown. Similarly, *C. equispiculus* studied by Sood (1968) showed strong differences with new nematodes in possessing equally long spicules: decreased anal papillae number, shortest distance of vulva to anterior end in females, increased number of buccal capsule ridges (Table 1.) and longer body in both sexes. However, *C. equispiculus* seem to resemble present nematodes in having excretory pore situated in anterior position (preequatorial) in both sexes.

By analyzing the present material with *C. testudineusi* (Gupta and Verma, 1978); *C. jullundurensis* (Gupta and Doggal, 1977); *C. sweeti* (Moorthy, 1937); C. *thaparus* (Sahey and Narayan, 1968); *C. anabantis* (Pears, 1933), found out that these nematodes differed not only due to bifurcated spiny tail tip absence, but also because of anal papillae number, the position of nerve ring, the shape and ratio of spicules length and the thick ring along longitudinal ridges. The present material, however, resembled them in number and shape of ridges, relative position of vulva and excretory pore excluding *C. thaparus* (Table 1.) and the caudal alae which is lacking in *C. testudineusi* and *C. jullundurensis* males.

The studied specimens can be differentiated from *Camallanus hypophthalmichthys* Dogel and Akhmerov, 1959 (Moravec *et al*., 2004) described in China by the absence of 3 small caudal processes on the mail tail tip, the highest measurements of body length in both sexes, the greater number of ridges and anal papillae pairs, the size ratio of spicules and by the absence of amphids and deirids as well. Once more, it differs from C. *hypophthalmichthys* in the presence of significantly shorter alae on males esophagus, shorter muscular and glandular parts of esophagus, and in having eggs instead of larvae in uterus and the vulva postequatorial. A part from above mentioned differences, it resembles new species in excretory pore position; shape of spicules and vulval lips morphology.

The new species *C. boomkeri* n. sp. when compared with materials from Europe, *C. lacustris* (Zoega, 1776) Moravec, 1994 and *C. truncatus* (Rudolphi, 1819) Moravec, 1994; North American *C. ancyclodirus* (Ward and Magath, 1916) Baker, 1979; *C. oxycephalus* (Ward and Magath, 1916) Stromberg and Crites, 1975 and from South American *C. maculatus* (Martins *et al*., 2007), these specimens had shown larger buccal capsule, greater number of longitudinal ridges and anal papillae (except *C. ancyclodirus* and *C. oxycephalus*) and the tail length in males. All most all traits may be differed, but tridents, smooth eggs in females of *C. maculatus*, postequatorial vulva and preequatorial excretory pore in *C. lacustris* and *C. truncatus* females (Table 1).

On the basis of differences of the present specimens compared with other species of *Camallanus* Railliet and Henry, 1915, it is concluded that the present materials are new to science for which the name *Camallanus boomkeri* is proposed in honor of Dr. Joop Boomker, who has great contribution in the field of Nematology.

Table 1 . Comparison of forms of Camallanus species reported from various fish hosts and localities of world including Pakistan

Parasite species	Fish host/ locality	Longi-tudinal ridges	Trident	Spicular ratio / spicules length	Papillae				Position of			Shape of eggs
					Pre-anal	Ad-anal	Postanal	Total	Excretory pore ♂	Vulva ♀	Excretory pore ♀	
Camallanus vachaii Wahid and Perveen, 1969	*Eutropiichthys vacha* Pakistan	20-22	absent	1: 4.82	7	0	5	12	unknown	Pre-equatorial	unknown	unknown
C. xenontodoni Khan and Yaseen, 1969	*Xenontodoni cancila* Bangladesh (East Pakistan)	9	absent	Unknown	_	_	_	_	unknown	Equatorial	unknown	Rounded smooth
C. barragi Zaidi and Khan, 1975	*Mastacembalus armatus* Pakistan	9	present	1: 2.7	5	0	3	8	unknown	unknown	unknown	unknown
C. charsaddiensis Siddiqi and Khattak, 1984	*Channa gachua* Pakistan	13-14	absent	0.42-0.43 single left spicule	7	2	6	15	unknown	All the female specimens are in larval form.		
C. adamsi Bashirullah, 1974	*Channa straitus* Bangladesh	19-20	present	1:1.62-2.84	5	2	5	12	Pre-equatorial	Pre-equatorial	Pre-equatorial	unknown
C. intestinalus Bashirullah, 1974	*Channa straitus* Bangladesh	23-24	absent	0.09-0.28 single left spicule	6-8	2	3-6	13-14	Pre-equatorial	Pre-equatorial	Pre-equatorial	unknown
C. pernandoi Yeh, 1960a	*Channa punctatus* Sri Lanka	9	absent	Unknown	_	_	_	_	unknown	Post-equatorial	unknown	unknown
C. kulasirii Yeh, 1960a	*Channa punctatus* Sri Lanka	9	vestigial	1:2.21-2.66	6	0	6	12	unknown	unknown	unknown	unknown
C. pearsi Yeh, 1960b	*Rasbora daniconius* Sri lanka	7	absent	Unknown	_	_	_	_	unknown	Pre-equatorial	unknown	unknown
C. salmonae Chakravarthy, 1942	*Salmo* sp. India	15	absent	Unknown	_	_	_	_	unknown	Equatorial	unknown	unknown
C. atridentus Khera, 1954	*Channa punctatus* India	20	absent	0.07, 0.156	5	2	3	10	Pre-equatorial	Pre-equatorial	Pre-equatorial	unknown
C. cancilai Gupta and Verma, 1978	*Xenontodon cancila* India	unknown	absent	0.08-0.10	8	0	6	14	Pre-equatorial	Post-equatorial	Pre-equatorial	unknown
C. gomtii Gupta and Verma, 1978	*Channa punctatus* India	20	absent	1:4.72-5.0	6	2	5	13	Pre-equatorial	Pre-equatorial	Pre-equatorial	unknown
C. kumaoni Arya, 1978	*Chrossocheilus lattius* India	18-19	absent	0.16-0.17 single left spicule	6	0	5	11	Pre-equatorial	Pre-equatorial	Pre-equatorial	unknown
C. satyapali Arya and Nama, 1993	*Barilius vagra* India	12 ♂ 15-16 ♀	absent	0.12 single left spicule	5	1	4	10	Post-equatorial	Pre-equatorial	Post-equatorial	smooth
C. nandai Gupta and Verma, 197	*Nadus nadus* India	9	present	0.053 single left spicule	5	0	5	10	Pre-equatorial	Pre-equatorial	Pre-equatorial	unknown
C. testudineusi Gupta and Verma, 1978	*Anabas testudineus* India	9	present	1: 2.48-3.35	8	0	6	14	Pre-equatorial	Postequatorial	Pre-equatorial	unknown
C. mastacembali Agrawal, 1967	*Mastacembelus armatus* India	9	present	0.076-0.336 single left spicule	9	1	3	13	Pre-equatorial	Pre-equatorial	Pre-equatorial	unknown
C. (*Zeylanema*)	*Rita rita* India	6	present	0.43-0.51 single	7	2	4	13	unknown	Pre-equatorial	unknown	unknown

varanasiensis Agrawal, 1974				left spicule								
C. equispiculus Sood, 1968	*Heterpneustes fossilis* India	11 ♂ 13 ♀	present	0.145 equal	5	0	6	11	Preequatorial	Pre-equatorial	Pre-equatorial	unknown
C. ophiocephali Shendge and Deshmuk, 1977	*Channa straitus* India	11	present	0.29-0.32 single left spicule	5	2	6	13	unknown	unknown	unknown	unknown
C. jullundurensis Gupta and Doggal, 1977	*Mastacembelus armatus* India	9	present	1: 2.0	7	2	5	14	unknown	Pre-equatorial	unknown	unknown
C. fotedari Raina and Dhar, 1972	*Nemacheilus kashmirensis* India	15-25	present	1: 1.3-1.45	6-8	2	6	14-16	unknown	Post-equatorial	unknown	unknown
C. aurangabadensis Soota, 1983	*Channa striatus* India	11	present	0.29-0.32 single left spicule	5	2	6	13	unknown	not known	unknown	unknown
C. sweeti Moorthy, 1937	*Channa straitus* India	9	present	1: 1.75-2.1	4-6	2	7	13-15	unknown	Post-equatorial	Pre-equatorial	unknown
C. unispiculus Khera, 1954	*Mastacembelus armatus*India	9	present	0.63 single left spicule	14	0	2	16	unknown	Post-equatorial	unknown	unknown
C. thaparus Sahay and Narayan, 1968	*Channa straitus* India	9	present	1: 2.0-2.5	7	2	4	13	unknown	Post-equatorial	unknown	unknown
C. luchnowensis Gupta and Bakshi, 1980	*Channa straitus India*	20	absent	0.12-0.13 single left spicule	3	0	2	5	Pre-equatorial	Pre-equatorial	Pre-equatorial	unknown
C. oxygasterae Gupta and Bakshi, 1983	*Oxrgaster bacila* India	20 ♂ 22 ♀	present	0.165 single left spicule	7	0	6	13	Pre-equatorial	Post-equatorial	Pre-equatorial	unknown
C. cotti Fujita, 1927	*Cottus polax* Japan	16	present	0.18-0.20 single left spicule	7	0	7	14	not known	Postequatorial	unknown	rounded smooth
C. (*Z.*) *anabantus* Pears, 1933	*Anabus testudineus* Thailand	9	present	1: 9.4-10.93	4-7	2	5-6	10-13	not known	Preequatorial	not known	unknown
C. hypophthlmichthys Duggal and Akhmerov, 1959 (Moravec *et al*., 2004) *C. lacustris* Zoega, 1776 (Moravec, 1994)	*Iristichthys nobilis* China *Perca fluviatilis, Anguilla Anguilla* Europe	13-16 16-23	present present	1:1.29-1.44 1: 1.3-1.83	7 7	0 0	6 6	13 13	Pre-equatorial unknown	Post-equatorial Post-equatorial	Pre-equatorial Pre-equatorial	Uterus contains larvae unknown
C. truncatus Rudolphi, 1819 (Moravec, 1994)	*Schizostedion lucioperca* Europe	14-20	Present	1: 1.47-1.50	7	0	6	13	Pre-equatorial	Post-equatorial	Pre-equatorial	Unknown
C. ancyclodirus Ward and Magath, 1916 (Baker, 1979)	*Cyprinuds carpio* United States	24-42	present	1: 1.13	7	0	4	11	unknown	Preequatorial	unknown	Uterus contains larvae
C. oxycephalus Ward and Magath, 1916 (Stromberg and Crites, 1975) *C. maculatus* Martins *et al*., 2007	*Morone chrysops, Perca flavescence* United States *Xiphophorus maculates* Brazil	21 26-28♂ 30-32♀	present present	1:1.75 1:1.78-4.6	6 7	0 2	5 4	11 13	Unknown Pre-equatorial	Pre-equatorial Equatorial	Unknown Pre-equatorial	Unknown smooth

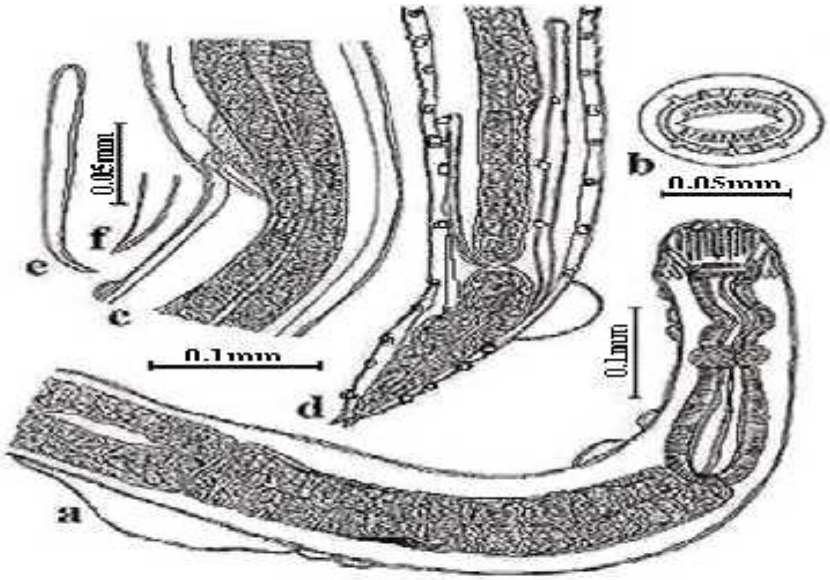

Figure-1. ***Camallanus boomkeri*** **n. sp., holotype male**
a. Anterior body region showing cephalic region, buccal capsule, tridents, nerve ring, muscular and glandular esophagus and part of intestine. Note the basal rings.
b. Enface view showing longitudinal ridges.
c. Region of excretory pore.
d. Posterior region showing large and small spicules, caudal papillae and bifid tail tip.
e. Small spicule enlarged.
f. Tip of large spicule enlarged.

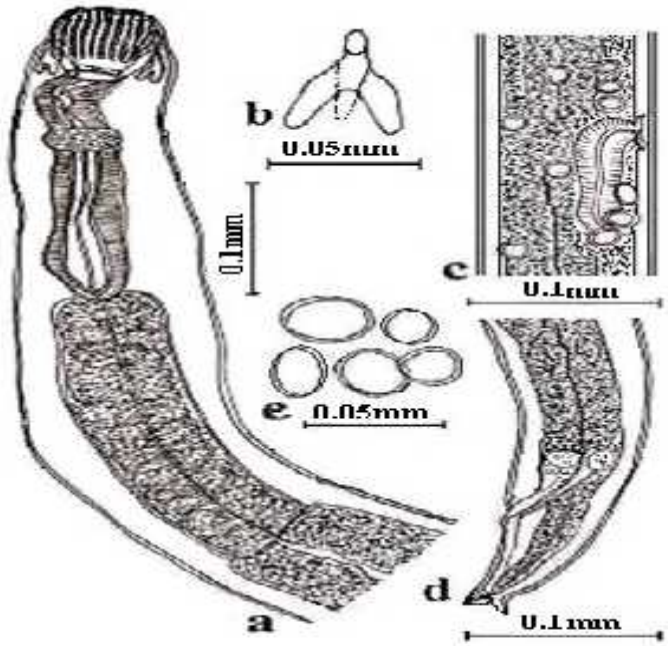

Figure 2. ***Camallanus boomkeri*** **n. sp., allotype female**
a. Anterior body region showing cephalic region, buccal capsule, tridents, nerve ring, muscular and glandular esophagus and part of intestine. Note the basal rings.
b. Trident enlarged.
c. Region of genital opening showing vulva, eggs and vagina.
d. Posterior region showing bifid tip and associated structures.
e. Eggs.

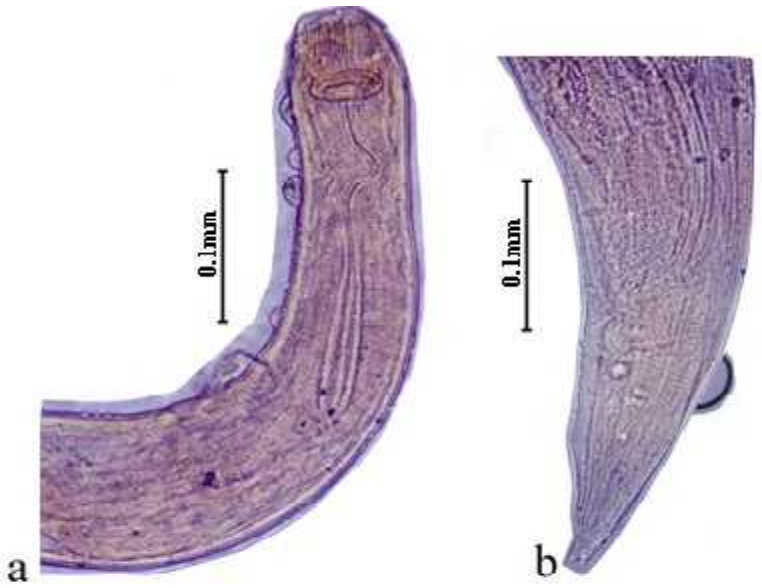

Figure-3. *Camallanus boomkeri* n. sp., holotype male
a. Anterior end of male, lateral view showing longitudinal ridges, basal ring, muscular esophagus and lateral alae on region of esophagus.
b. Posterior end lateral view showing caudal alae and bifid tail.

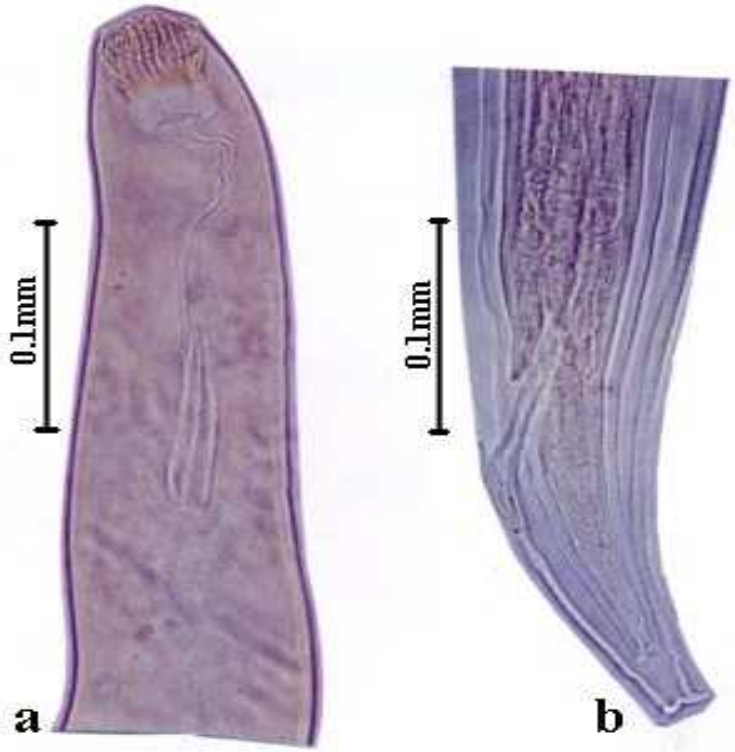

Figure-4. *Camallanus boomkeri* n. sp., allotype female
a. Anterior end of female, lateral view showing longitudinal ridges, basal ring, muscular esophagus.
b. Posterior end, ventral view showing bifid tail.

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